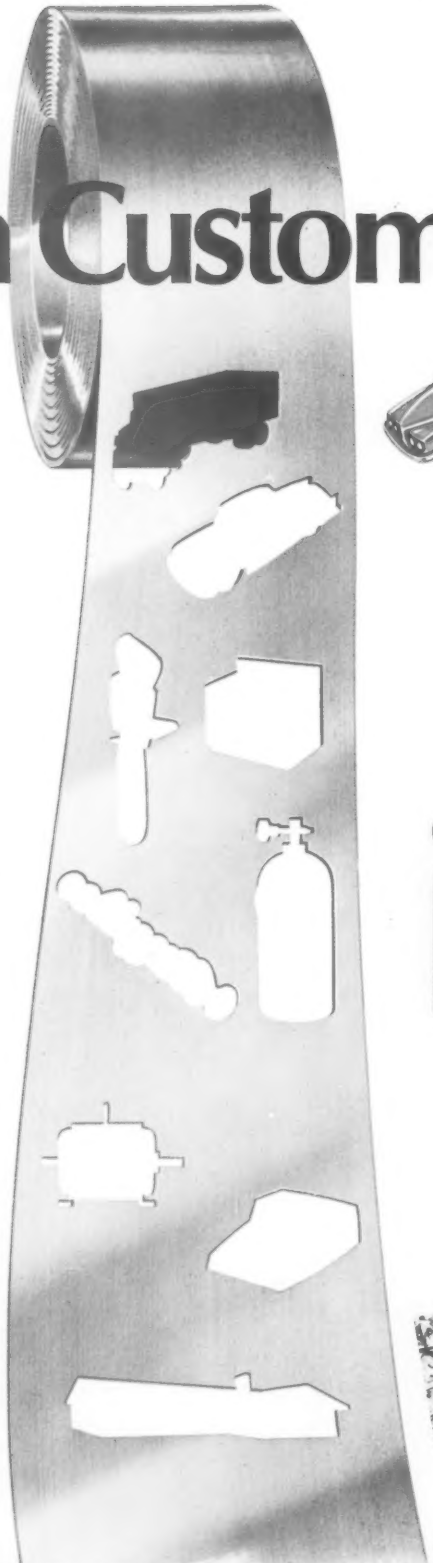
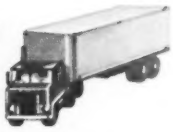
Manufacturing PLANBOOK: 1974

MAKE IT BETTER WITH Sharon Custom Steels



HIGH STRENGTH LOW ALLOY



High strength-to-weight ratios make these steels the lower-cost way to upgrade products without increasing weight. Sharon produces the most popular types: Sharalloy®, Cor-Ten® and N-A-X®.

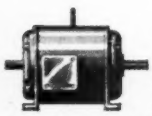
ALLOY

Sharon, *the* alloy steelmaker, produces all the standards, plus the industry's widest selection of special-purpose alloys. Sharon metallurgists will tailor an alloy steel to your exact requirements.

FORGING QUALITY

Because these steels are specified for highly critical applications, Sharon offers the best in steels and in technical assistance to improve forged products. Every billet, ingot, bloom and slab is thoroughly tested to insure performance in the finished part.

MOTOR LAMINATION



Sharon's motor lamination steel is in high demand because its consistent gauge prevents distortions in the stack; because of its superior internal cleanliness, and because its electrical characteristics are completely uniform.

COATED

In addition to regular hot-dipped galvanized steels, Sharon offers a family of wiped galvanized products characterized by unusually even zinc distribution, plus steels electro-galvanized on one or both sides.

CARBON

Sharon produces the full range of low, middle and high carbons, for applications ranging from high-speed stamping through clutch discs and cutting tools to springs and fasteners.

ENAMELING STEEL

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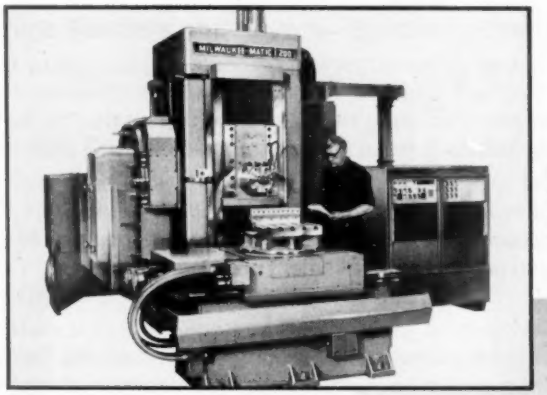

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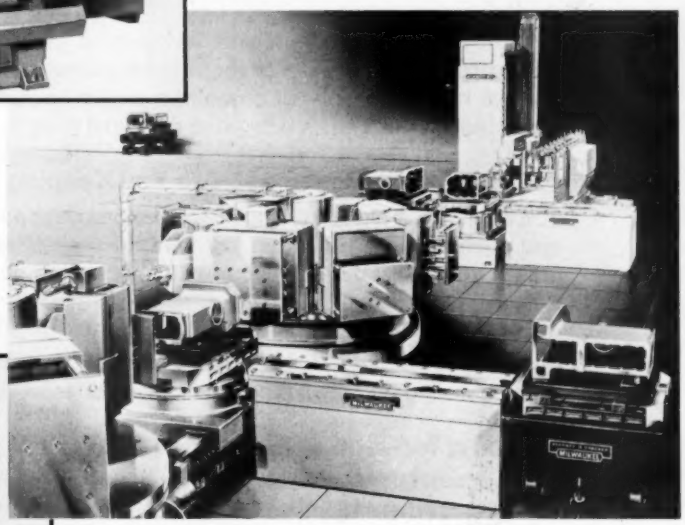

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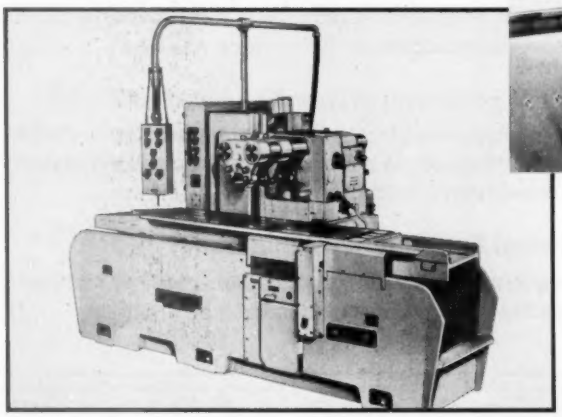

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PRODUCTION's

Manufacturing PLANBOOK: 1974

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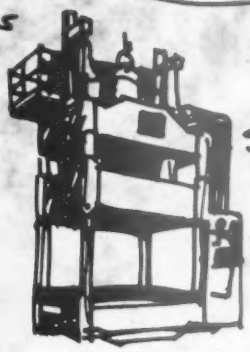

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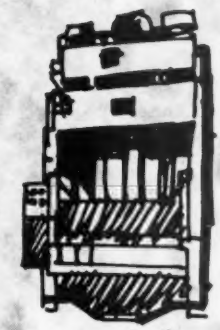

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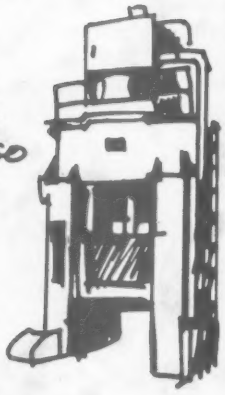

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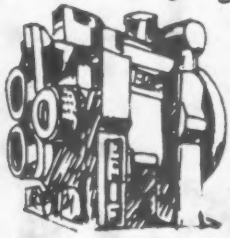

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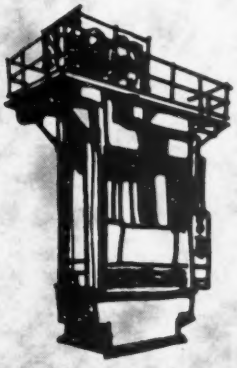
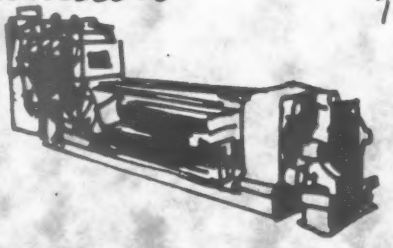
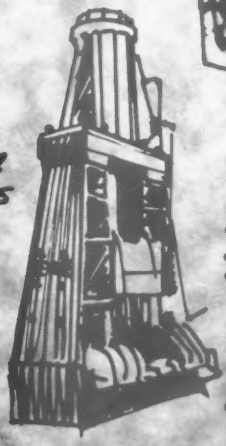


Carbon Extrusion Presses



Compacting Presses and many other Custom designed machines



Standard Forging Hammers - Single & Double frame - Steam, air and Board Drop... Part of our complete line of Forge Shop Equipment

WHY THE PLANBOOK?

First, many manufacturers have told PRODUCTION's editors they'd like to work more closely with vendors. They would like the vendors to be more fully informed about the problems to be solved. They'd like to know what solutions the vendors are working on while there is still time for user comment and influence.

Second, in this time of shortages, allocations, product changes, energy problems, et al, planning is often the only way out of critical economic and market problems.

This Manufacturing PLANBOOK: 1974 is intended to serve you as a working tool for the year. It can show you how better to do your job. You'll learn about the economic climate, hazy as the view might be, for 1974, including how others will invest in capital equipment. There is a worksheet you can use, or modify, to assist you in your own planning. Some new insight into the impact of OSHA is revealing.

Finally, in eight sections you'll read about the technological problems confronting your peers, and of solutions ready, or on the way, to ease or erase the problems. Don't fail to consider and use the wealth of available information included in the "useful literature" columns at the end of each section.

The Manufacturing PLANBOOK: 1974 is yours for the year . . . to be pulled out and reused whenever it can assist you.

It is the first of a kind. The editorial staff which produced it is already at work on the plans for the next one. We want to make it an even more vital source of information you can use in planning and executing your job. Please let us know how you feel we can make the information more meaningful or helpful to you. What information would you like to have that is not in this first PLANBOOK? Please send any ideas you have to us.

Meanwhile, it is our hope the information in this issue, furnished by more than 100 authorities in industry, will be of value to you and, therefore, to your company. We hope it helps make for a better 1974.

Robert F. Huber

PLAN YOUR OWN SUCCESS

TED POLLOCK

Any machine that performed as inefficiently as a man would be yanked off the market.

For nobody—but *nobody*—works at anywhere near his full potential. Most of us, it has been estimated, chug along at 15-20 percent of our true capacities. During periods of stress, we may increase our performance coefficient fractionally, but generally we work on only a few cylinders. To be sure, occasionally an Edison or an Einstein appears on the scene and dazzles the world with a sustained performance that may represent 30 or even 35 percent of what he is really capable of, but the average mortal bumbles along, trailing clouds of inefficiency behind him.

While there is no known way for a person to even approach 100 percent of his potential on the job (and if he did, he would without doubt be summarily lynched by his colleagues), there are a number of ways in which he can improve dramatically.

Basically, there are two approaches to the problem of personal unproductivity. First, you must take a hard, long, objective look at yourself and your performance, spot your weaknesses and correct them. And second, you must learn—or relearn—how to use your time and energy to best advantage.

First things first.

PART I— TAKE STOCK OF YOURSELF

Most men sit down periodically with their immediate superior for an appraisal of their on-the-job performance. But precious few ever enter into "executive session" with themselves. Yet, taking stock of yourself is important for it can help you see where you've been, where you are, where you're headed. Here are some areas to investigate:

Are you on schedule? Are you advancing as fast as you want? Are you earning what you think you should be earning at this stage of your career? Have you been adding to your skills, know-how, responsibilities? If, upon assessment, you must admit that you are in the doldrums, now is the time to set fresh goals, plan a new strategy.

Are you respected? Do your co-workers look up to you? Is your boss aware of your contribution to the department or business? When was the last time you received tangible proof of the value placed on you (a raise, award, promotion, etc.)?

Are you famous? That is, is your name well known in your company? When the work of your department or the kind of skills you possess are discussed, is your name apt to be mentioned? Have you ever been put on "detached service" to another department or task force because your expertise was needed?

Are you taken seriously? Have you been marked as a "comer," an idea man, someone whose advice is to be sought and followed?

Are you happy? Probably the most important question of all. Not everyone aspires to the top,

The most important planning you can do is on yourself. How you operate will basically determine what and how much you can accomplish. Ted Pollock helps you examine the things that keep you from being as productive as you can be. He also offers four do-it-yourself tests that will help you spot problem areas for improvement.

nor should everyone. Some are unsuited to it by temperament. Others place other things ahead of personal advancement, big money, or power. If you are content in your work, derive satisfaction from it, feel that your talents are being fully utilized and lead a well rounded life, you're a success.

If, on the other hand, an honest self-appraisal leads you to conclude that you are *not* happy, that you feel unfulfilled by your work, that your talents are *not* being used maximally, that—in short—something is definitely wrong, then it's time to look deeper.

Few of us are the victims of a concerted plot. Our bosses do *not* lie awake at night, dreaming up ways to frustrate our plans, our work, the realization of our goals. Our co-workers are *not* continually scheming to negate our accomplishments.

We are *not* born star-crossed.

This is to say that, in 999 out of every 1000 cases, *we* are the architects of our destiny, the moving force behind what happens to us, the final cause of how we act and what we do.

That being so, if we do not achieve what we are capable of achieving, the weakness almost always has its roots in some personal "hang-up."

Two in particular warrant discussion: habits and attitudes.

A. BAD WORK HABITS. There are certain on-the-job practices that are guaranteed to block accomplishment. If any of these sound familiar, change them.

1. *Procrastination.* Faced by a large job, the procrastinator will find a dozen "little" things to attend to before tackling it. Faced by a little job, he will put it off because "it can be done in a few minutes." Either way, he does nothing.

2. *Lack of planning.* You get wherever you're going a lot faster if your know your destination. Basic stuff? Perhaps. But most people ineffectually muddle through simply because they've never pinpointed in their own minds precisely what they have to do. They coast haphazardly through their days, relying on "inspiration," chance and scrambling last-minute activity to do their work. Results are a foregone conclusion: poor.

3. *Indecision.* This habit is the result of either lack of pertinent information on which to base a decision or lack of confidence in one's ability to think through a problem. By putting off a decision, the postponer is really demonstrating his desire for someone else to make it for him. He is also paralyzing initiative and wasting time.

4. *Knee-jerk reflexes.* The habit of responding to new circumstances in old ways may be initially comfortable, but by its very nature it is anti-creative and nonproductive. New problems demand fresh solutions. And the only way to arrive at fresh solutions is through fresh thinking.

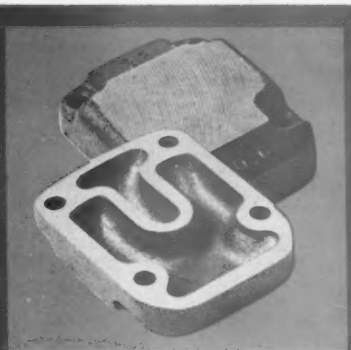
B. HARMFUL ATTITUDES. Habits are merely the more visible signs of attitudes. So if you are to rid

continued on page 9

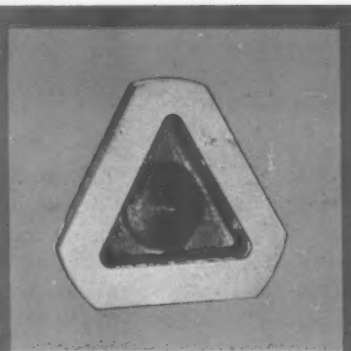
FLAT MACHINING?

YOU MAY BE PERFORMING TWO OPERATIONS WHERE ONE STEP COULD DO IT (BETTER).

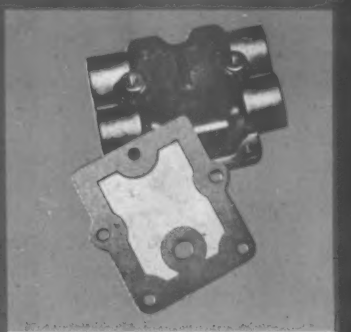
Fuel Injection Nozzle. Formerly ground, then lapped. F-AM process eliminates one step!



Compressor Valve Cover. First side formerly ground for reference, second side ground then fine ground. F-AM saves two steps!



Gasoline Pump Part. Formerly faced (turned), then ground. F-AM process eliminates one step!



Explosion-proof Housing. Formerly milled, then hand finished. F-AM process eliminates one step!

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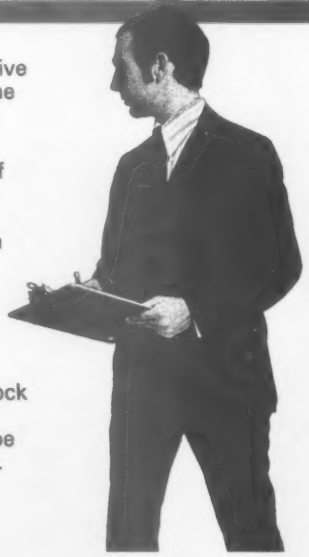

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PLAN YOUR OWN SUCCESS

continued from page 7

yourself of the bad ones, it is necessary to attack the substructures on which they rest. Among the most harmful are:

1. *Mediocrity.* While no one consciously believes he is dedicated to "just getting by," he is guilty of this attitude if he customarily settles for the first idea that comes to mind . . . if he accepts the status quo without question . . . if he takes dangerous shortcuts in the name of expediency . . . or if he never deviates from "the book."

2. *Boredom.* Any job loses its excitement with the passage of time. But the worker who takes no steps to find something interesting in what he does or to inject his own excitement into it is dooming himself to below-par performance.

3. *Discouragement.* There are some people who cannot snap back when they're thrown for a loss. An idea of theirs is criticized? They'll never come up with a new one. They didn't solve that problem immediately? What's the use of trying? But no one goes through life chalking up one success after another. Doers *do* despite set-backs.

4. *Lack of self-motivation.* You can't always rely on others to provide the propelling force you require to get things done. They have their own needs, problems and responsibilities. Somehow, you must learn to trigger enthusiasm and action within yourself. You must cultivate a certain personal pride in the calibre of your work and an eagerness to accomplish that enables you to overcome discouragement, boredom, and assorted set-backs.

PART II— R FOR PRODUCTIVITY

Awareness of the habits and attitudes that hamper accomplishment is important, for once you know what they are, you can take steps to correct or eliminate them from your character. But this knowledge is only half the battle. Equally important is understanding—and doing—the things upon which solid achievement is based.

Here are some of the most important:

A. SET PRIORITIES. The logic of this is simple. You can do only one thing at a time. If you try to do that one thing while worrying about the other jobs you can't do at the same time anyway, you'll take longer on the job you are doing and fall further behind.

So always list the jobs you must do in the order of their importance and tackle them one at a time. Forget the others until you've finished the one you're working on.

In the office or in your pocket, a daily calendar is essential. If a new job has to be started or followed up next Wednesday, note this on Wednesday's page and *forget about it* until Wednesday. If a letter has to be answered after you get some needed information, *don't* keep the letter on your desk while you wait a couple of days for the information. Slip it between your calendar pages or—if you have many such letters—into the Thursday folder. You'll spot it Thursday and, if you haven't received the information, it will remind you to follow up.

Put everything you can on a timetable. Note it down and forget it until the right time comes.

B. ESTABLISH TIME LIMITS. After you decide the importance of the tasks before you, set time limits on their accomplishment.

Tell yourself, for example, that you will definitely have those blueprints ready by Tuesday . . . read those reports before lunch . . . draft that memo before the day is over.

There are three good reasons for setting deadlines.

1. *You challenge yourself.* Everyone cherishes a certain image of

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Do You Control Your Work or Vice Versa?

It's amazing what you can get used to. Some people believe it's normal to feel overwhelmed by their work, simply because that's their usual state. You? Here's a friendly challenge—10 questions that will tell you quickly whether you are in the saddle or whether things are riding you:

1. Is your work piling up too fast?
2. Do you spend evenings or weekends "catching up" with work?
3. Are you usually pressed for letter-answering time?
4. Do you find yourself with too little time to see people on business matters?
5. Do you lack time for thinking?
6. Are you frequently late in meeting deadlines?
7. Are you habitually swamped by details?
8. Look at your in-box. Are any matters that should have been attended to still "hanging fire?"
9. Do you feel stale?
10. Have you been irritable lately?

If you answered even one question affirmatively, you can profit from learning to plan and to delegate.

PLAN YOUR OWN SUCCESS

continued from page 9

himself and will do anything to sustain that "self-image." Almost everyone's "self-image" includes a sense of honor. We like to believe we can be counted on. By establishing a time limit in which to accomplish something, we are in a sense challenging our good opinion of ourselves. In order to meet that challenge, we summon all our capabilities. It amounts to "saving face" in front of yourself —and is a powerful incentive.

2. *You alert your body.* Sit in an easy chair and your muscles relax. You breathe slowly, your pulse beats at a normal rate. But get up with the intention of lifting that easy chair and your muscles, anticipating the job before them, flex and tighten; you breathe faster in order to deliver the extra oxygen your body requires for work; your pulse quickens as your heart pumps more blood to all parts of your body. Many other subtle physical changes take place.

In the same way, the knowledge that a certain task must be accomplished by a specified time alerts your body to prepare itself for the job at hand. Even if the assignment is mental, writing a report for example, your body responds by sending more blood—and oxygen—to the brain.

3. *You are being affirmative.* "If you think you can, you can," it has been said. When you say to yourself, "I'll paint my bedroom this weekend," you are really declaring your ability to paint your bedroom within that time period. And it's always easier to do something when you know you can do it.

Clearly, however, it is important that you—

C. KEEP YOUR DEADLINES REALISTIC. The best laid plans don't always work out. Allowances must be made for unforeseen obstacles, interruptions and necessary changes in plan. Your deadlines, therefore, should be reasonable. If they are not, and you fail to meet them, you risk frustration and loss of confidence.

To avoid either pitfall, bear the following in mind before you set your time limits:

1. *Allow sufficient time for fact-gathering.* Many tasks require specialized information: reports must be read, people consulted, phone calls made. Take these preliminary steps into consideration when establishing your deadline.

2. *Don't forget the tools you will need.* Whether your task calls for paper clips or power tools, remember the time it will take to beg, borrow, or buy the proper equipment.

3. *Interruptions cost time.* Phone calls, visitors, conferences, little emergencies—all can toss a deadline for a loss. Unless you've already found Shangri-La, make allowances for these petty time thieves.

4. *Your energy supply varies.* We all experience bursts of energy and short circuits. On a day you *know* you're clicking, you can shave your deadlines, confident that you will meet them. On "off" days, give yourself leeway.

By keeping your time limits realistic, you will avoid the "doing

Are You Your Own Worst Enemy?

Accomplishment starts with proper attitudes and good habits. Think failure and you will fail. Lack discipline and organization and you will fall hopelessly behind in your work. Take this little quiz to determine whether *you* are your own chief bottleneck.

1. Do you approach every job confident that you can do it?
2. Are you too easily satisfied with your own performance?
3. Can you predict with a fair degree of accuracy what you will be doing next Monday? Next week? Next month?
4. Do you usually have everything you need—information, equipment, tools—before starting a job?
5. Are you habitually guilty of finding "little things" to attend to before diving into a project?
6. Do you welcome interruptions on the job?
7. Do little frustrations throw you off your pace?
8. Do you keep your telephone conversations brief and business-like, or allow them to lure you into time-devouring bull-sessions?
9. Frankly, would you characterize yourself as a clock-watcher?
10. Does criticism of any kind tend to upset you to such a degree that you cannot get back to work?
11. Are you often bored by your job?
12. Do you approach problems as challenges to your skill and ingenuity or as frustrating blocks to further achievement?
13. With due allowances for the occasional exception, can you honestly say that you look forward to going to work?
14. Do you learn from your mistakes, or tend to repeat them?
15. Compared to the work turned out by your colleagues, how would you characterize yours: below-average, average, superior?

If you have been perfectly candid, you have probably identified one or more habits or attitudes that can stand improvement. Take the necessary steps.

man's" arch-enemy, "deadline jitters," that unreasoning jumpiness that can paralyze your faculties and triple the difficulty of any job. A deadline is like a suit: Too tight or too loose, it doesn't allow a man to show himself at his best; but carefully tailored, it flatters, builds confidence, and is supremely practical.

D. ELIMINATE THE UNNECESSARY. Common sense tells us that if we can simplify our work, we will save time and get more done.

Answer the following questions about the way you now do any job:

1. *What are the separate steps I take in doing it?* Write them out, in order, so that you can study them.

2. *Can any steps be skipped without spoiling the result?* Frequently, we do things simply because we have always done them. Look over your steps to see if any can be eliminated or combined without affecting the quality of the results.

3. *Can the order of the steps be changed?* Just because you've always done ABCD, it doesn't necessarily follow that ACBD might not be more effective.

4. *Are there any chores that can or ought to be done by someone else?* A major stumbling block to achievement is the inability to delegate. Few have mastered the knack of separating the things that only *they* can do from the things that *others* can. For example, can an assistant or secretary dig up information for you? Look over the steps you take on a job to see if you can delegate any of them.

E. STAY OUT OF DEBT TO YESTERDAY. You've seen them: people who, when Friday rolls around, are frantically working on Wednesday's chores. Panic-stricken, they cannot do their best; in despair, they turn out slipshod work, hoping it will "get by."

Setting deadlines can help you side-step these "traffic jams." But let's face it. Sometimes things do go wrong and try as we may, comes 5 p.m. there are still things to be done.

There is but one solution: *do them!*

The 20 or 30 extra minutes you spend in cleaning up a day's work will pay handsome dividends in self-discipline, peace of mind, and confidence. You will avoid that feeling of overwhelming defeat that greets those who must start each day by paying their debts to yesterday.

Many people even work overtime to start *tomorrow's* job the night before. In the morning, they get a psychological lift from finding the new task already begun: They can plunge right in and finish it.

Actually, they are taking advantage of a well known psychological fact: Our memory for uncompleted tasks, sparked by the unresolved tensions they create, is 1000 percent greater than our memory for completed ones. When you leave a job unfinished, your subconscious—that silent ally always on duty—goes to work on it. Later, when you return to the job you are often amazed to discover that you have a whole new arsenal of ideas, approaches and solutions to draw from.

F. DISCOURAGE INTERRUPTIONS. Among life's frustrations are the well-intentioned interruptions of your work by friends, relatives, and co-workers. Some hints on making yourself less accessible when you really need to:

1. Try rearranging your lunch hour so that you are on your job when your co-workers are out eating. Sixty blissful minutes of golden silence!

2. Shift your furniture. You may look too inviting in your present set-up. Try facing the wall or working with your back toward others.

3. Be firm and let your co-workers, friends and family know that at certain hours of the day you are strictly "off limits."

4. Find an inaccessible place to work—an empty office, the public library.

5. Let your secretary—or, at home, your wife—screen phone calls, intercepting those of little importance.

G. TAKE "BREAKS" TO RECHARGE. You can be more effective on the job and save time in the long run by spending time to get a fresh start. Sir Winston Churchill and President Truman, both masters of the catnap, testified to its power to recharge energy. Bernard Baruch credited his habit of relaxing on a park bench for his ability to bring fresh thinking to a problem.

You may not be able to indulge in catnaps or leave your job and head for a park, but you can take the kind of "breaks" that will have the same beneficial results. Some ideas:

1. A steaming cup of coffee at 11 a.m. or 4 p.m. can clear your mind for action, pep up your body. Dream a little while you sip. It's the next best thing to 40 winks. If coffee's not your cup of tea, try tea—or your favorite soft drink.

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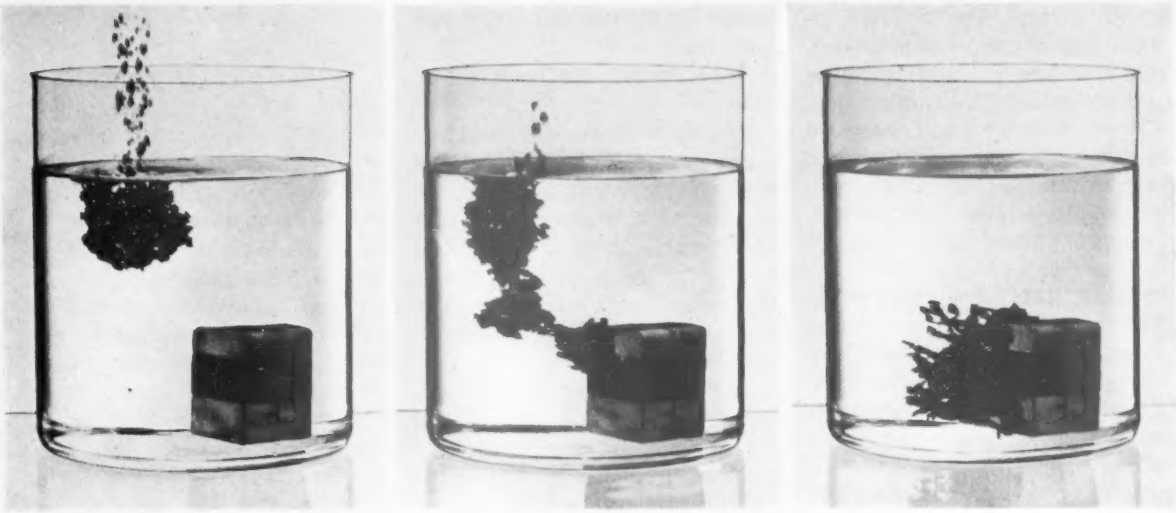
Identify Your Personal Gremlins

Improved performance seldom depends on more muscle. It is usually a case of working smarter, not harder. If you want to outwit your personal work gremlins, try this proven technique. In terms of your own job, answer these questions:

- What made me mad today?
- What took too long?
- What was the cause of a complaint?
- What was misunderstood?
- What cost too much?
- What did I waste?
- What was too complicated?
- What was just plain silly?
- What job required too many people?
- What job didn't get done?

Your answers will almost certainly provide you with a number of areas crying for improvement. Once you identify them, you can search for solutions.



AN ATTRACTIVE WAY TO GET YOUR COOLANT CLEAN.

Magnetism. A shovel can remove some chips and fines from coolant. A filter screen works a little better, but when you want to get *all* the chips and fines from the coolant that cause clogging and costly downtime, a magnetic system works best of all. And Van Straaten can engineer the right separator/conveyor system to meet your specific needs.

Here's how it works. An enclosed magnetic system (using same magnets shown in photos) runs under a stainless steel slide, pulling chips and fines up the slide and out of the coolant...for good. No jamming. No work stoppage.

Sound attractive? For more detailed information contact: Van Straaten Chemical Company, Magnetic Equipment Division, 630 West Washington Blvd., Chicago, Illinois 60606, (312) 454-1000.

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From the people who make quality coolants... the best way to maintain coolant quality.

PLAN YOUR OWN SUCCESS

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2. Gaze out a window for a few minutes. Good for your eyes, a tonic for your brain.

3. Take a few deep breaths and stretch. Sometimes, we get drowsy simply because our bodies are oxygen-starved. Fill those lungs with fresh air, loosen muscles with a good stretch, and snap out of that slump.

4. Eat a candy bar. Sugar is an ace pepper-upper. Of course, if you are fighting a personal battle of the bulge, this may not be for you. But now and then, for a change of pace, munch.

H. BE DECISIVE. No matter how you earn your living, you must choose between alternative courses of action hundreds of times each year. Reluctance to make a choice sabotages action and, therefore, achievement.

To acquire the habit of decisiveness, try these four rules:

1. Decide the small things promptly. By getting them out of the way, you give yourself more time to think through the things that really count.

2. Select your choices firmly. It will put iron into your resolution.

3. Abandon all alternatives. Once your mind is made up, forget the other possibilities. They are ancient history. "What-could-have-been" thinking is unproductive.

4. Act upon your decisions. Nothing really happens until you *do* something. So if you truly want to be decisive, you must carry out your decision through action. And don't be afraid to make a mistake. J. P. Morgan once defined a successful man as a "a fellow who is right 51 times out of 100." Right or wrong, *come to a decision promptly.* Whichever it is, it is almost always better than no decision at all.

I. BUILD VICTORY ON VICTORY. The inclination to relax and savor a particular achievement is very human, but bad psychology. When you have accomplished something really worthwhile—solved a tough problem, finished a demanding report, made a breakthrough of some kind—don't stop to celebrate. Go right on with your schedule. Tackle the next problem. After a victory, you're seething with confidence. Your enthusiasm, as well as your thought processes, is at concert pitch. This is precisely the time to confront your next most nagging task. Failure doesn't matter so much on the day of conquest because you're already successful. In this relaxed, confident frame of mind, you will probably make some headway on those toughies. And even if you don't, you're laying a solid foundation for future accomplishment.

J. STRIVE FOR PERFECTION. The best of us tend to view their work, after a while, as routine; consequently, there is the ever-present danger of settling for mediocrity. If you would like to upgrade the quality of your work, try this extraordinary experiment.

For two weeks, be a perfectionist. Take infinite pains with every detail of your job. Write letters over as many times as necessary to make them say precisely what you mean, no more, no less. Review and modify decisions until they appear flawless. Handle each task like a great artist putting the finishing touches on his masterpiece. Obviously, you are responsible for a certain volume of work and cannot be an absolute paragon at all times, but the discipline of this two-week-long experiment will carry over to your future work and leave an indelible stamp of quality on it.

In a sense, you are a factory—responsible for a certain amount of high-quality output. From a productivity viewpoint, you are—unfortunately—also a human being, subject to a thousand mortal shocks, ranging from sleepless nights to humid weather.

But going for you is the fact that, unlike any factory that ever existed, you have a will, a conscience, and an imagination. You have merely to harness these three incomparable advantages to unleash more of the potential locked up within you. ■

Check Your Environment

How you feel determines to a large degree how well you function. Here is a handy checklist that enables you to see if you are physically prepared to tackle a job. Before diving in, make sure you can say "yes" to these questions.

- Am I well rested?
- Have I eaten properly?
- Am I dressed comfortably for the work I have to do?
- Is the temperature set for optimum work?
- Is the lighting adequate?
- Have I eliminated all distractions?
- Do I have all the equipment I'll need to do the job?

If your answers are in the affirmative, you can be sure that you are physically prepared to get to work. If you've answered any of the question negatively, correct the situation before you go further.

All the tools for better management control

...plus the simplicity of "single source" responsibility
from Waterbury Farrel and its
Jones & Lamson, Cleveland Hobbing, & Thompson Grinder divisions.

Jones & Lamson

TNC Turret Lathes

J & L's new generation of TNC lathes provide utmost versatility for both internal and external work...simplified programming...assured accuracy ...faster cycling. Complete interfacing for selection of 2, 3, or 4 axis systems, plus Mini-Computer with stand-alone or multiple machine capability, or Direct Computer Control. Over 20 different models. Capacities range from ½" to 10" bar, 8" to 36" chuck sizes, up to 72" between centers, and 15 to 90 HP. **Plus J & L's "no charge" TNC Training Programs;** designed to help users get top performance from their machines. Included are intensive Tech Center training of your people; extensive library of video tape training films, plus loan of equipment; TNC literature; and continuing TNC service program.

Waterbury Farrel

Cold Forming Machines

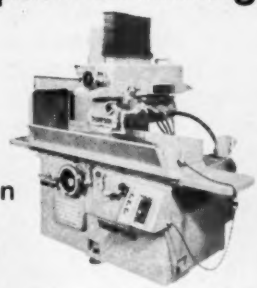
For economical production of bolt and screw blanks, rivets, nuts, slugs, and special-shape parts from ferrous and non-ferrous wire, take your choice from our complete line of cold headers. Includes solid die double stroke, two die transfer, Raycarl, and progressive headers, bolt making, nut forming, and thread rolling machines. Short setup time, easy access for quick adjustment, and rugged construction have made them the standard of the industry. Wire diameters from ⅛" to 9/16" (1⅝" for progressive header). Speeds up to 450 pieces per minute.

Cleveland Hobbing

Rigidhobbers

Latest model Cleveland Rigidhobbers combine proven high production features with job shop versatility. Insure fast job changeovers. Have infinitely adjustable stroke from 0" to 4"; extra rigidity to handle heavy pitch gears; "0" cycle for automatic hob withdrawal; plus, your choice of versatile hobhead, including Continuous Automatic Shift (CASH), new combined Continuous Automatic Shift and Incremental Shift (CASH-IN), or manual shift. CASH and CASH-IN insure complete uniform hob usage and lowest hob cost per piece. Hob speeds from 75 to 600 RPM. Gear blanks up to 18" diameters. Multiple spindle rotary models available.

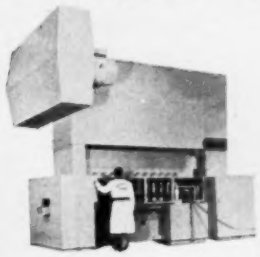
Thompson Grinding



Thompson Surface Grinders

There's a Thompson machine that fits your surface grinding requirements to a "T". Rock-solid construction insures precise accuracy. Exclusive features expand your operating flexibility and economy; give you longer life of repetitive accuracy; less maintenance; faster cycles; fewer adjustments; better feed response; better finish; and full capacity with no power loss; plus, your choice of spindle bearings (ball or roller) so you can tailor the spindle to the job. A wide selection of automatic controls with digital readouts simplifies operation. Sizes range from 6" to 96" width, 12½" to 60" height, and 18" to 384" length.

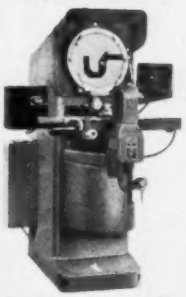
Waterbury Farrel



Transfer Presses

Blanking, cupping, drawing, forming, trimming, transfer, and ejection—you can do them all in one continuous succession of automatic operations with a Waterbury Farrel transfer press. Fast, versatile, with simple, easy-to-change tooling...Models for both job shop and high volume production operations. Provide up to 12 independent stations in each press, synchronized and integrated by the transfer mechanism to insure **Positive Part Control.** Truly "one-machine production lines" for drawn metals parts...from strip stock to finished part. Blank sizes up to 16" diameter. Drawing depths to 8½".

Jones & Lamson



Optical Comparators & Precision Measuring Machines

For fast, accurate management control of quality assurance these precision machines provide a full range of inspection methods, including comparison, co-ordinate measuring, surface inspection, tracing, and optical sectioning. All 11 standard models give you distortion-free full screen accuracy with a single setting. No time-wasting computations—all measurements are read direct in .0001" increments. Standard magnifications from 5X to 750X with exclusive J & L computer-verified lens systems. Screen diameters from 10" to 50". Measuring table size range: 4⅛" x 16" up to 8½" x 32".

WATERBURY FARREL

WEST JOHNSON AVE., CHESHIRE, CT. 06410 A textron COMPANY

INDICATE NO. 208 ON BUSINESS REPLY CARD

PLANNING for CHANGE

"The first guideline is make our search for improvement systematic, rather than merely opportunistic. With an opportunistic approach, improvement efforts will zero in on the more obvious programs, ones that obviously need doing and that offer the promise of lucrative results. Certainly we should make these obvious improvements, but the drawback of this kind of an approach is that it soon runs its course. The availability of such obvious improvements is limited—you won't find many of them left in the everyday world. And once you skim off the top layer of ready-made projects, the opportunities dwindle away.

"But with a systematic approach, good improvements will continue to be discovered and opportunities to improve productivity will be found year after year. This approach makes it possible to spend our time and energy on the most worthwhile—not merely the most obvious—projects. A systematic effort gets people in the habit of questioning the old way of doing things, the old ideas. It discourages complacency and an unquestioning adherence to yesterday's way of looking at the world."

Thus D. C. Burnham, chairman, Westinghouse Electric Corp., sets the stage for a look at what can constitute an orderly, planned approach to change, to initiating, working out, justifying, and selling any proposal for new equipment, processes, tools, or materials. His remarks were made during his Benjamin F. Fairless Memorial Lectures, sponsored by Carnegie-Mellon University, Pittsburgh, Pa.

Surprisingly, few companies have an organized plan for changes in manufacturing. Most have rules on how fast the payback ought to be (the average is about two years), and they have formal procedures for filling out the forms for a project proposal.

But when it comes to giving solid guidance to the production or manufacturing engineer or manager responsible for making changes, the system is mostly a vacuum. Normally, the incentive is more profit or less cost (or both), and the company seems to act as if the motive will somehow naturally produce the result. You take whatever steps are necessary and all will be well.

It's not so. Without some kind of a plan, your progress on a program for change can be rapid at times, slow at others, and you can completely omit steps either because they are unpleasant or because you forget them.

In this section of Manufacturing PLANBOOK: 1974, we suggest an outline that can be developed and tailored into a wide variety of planning procedures. Hopefully, you can adapt it, or parts of it, to assist you in being ready at each of the important decision points.

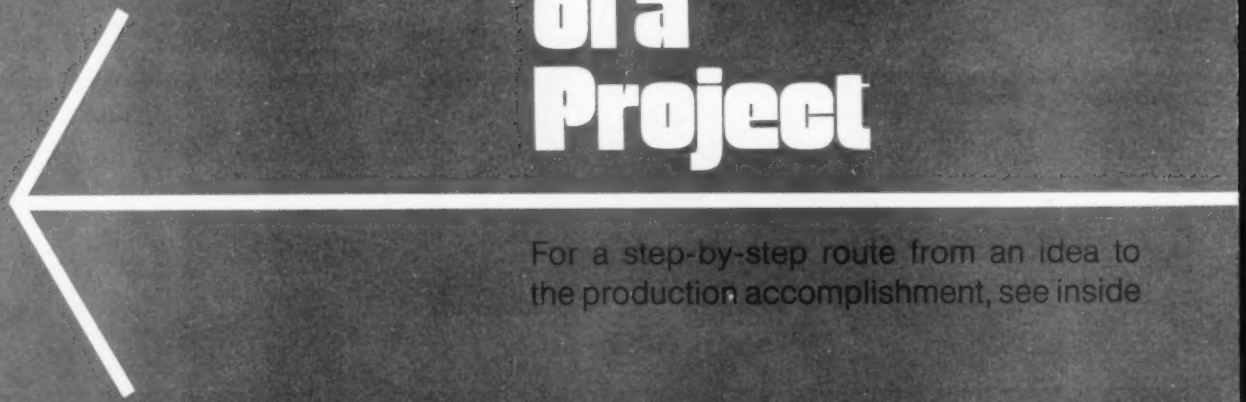
Alpha and Omega. The project begins with a need. And it ends with full, satisfactory production; or, even better, it ends with a post-audit to make certain that what was planned is what is happening.

"Almost all the time, the need is told to us by management," laments a manufacturing engineer at a company that has three plants. "We need more capacity, or we're adding a new product, or the market is too competitive and we've got to squeeze 10 percent more out of costs we have been squeezing for a decade. And now lately, we receive a couple of volumes that have to do with government regulations, and we're told to make certain we comply."

These are genuine needs. The engineer doesn't deny it. But in almost every one of these cases, innovation is difficult and risky. As Rudolph Krueger, director, manufacturing engineering, American Motors Corp., told PRODUCTION: "When the first thing you need is production, you go pretty much with conventional equipment. When the pressure is on for parts, you go with what you know will work." *continued on page 21*

PRODUCTION's

Evolution of a Project



For a step-by-step route from an idea to the production accomplishment, see inside

PRODUCTION's

Evolution of a Project

Stage 1

Basic Objective

- ☐ Add capacity
- ☐ Cost reduction or profit improvement
- ☐ Redesign or new product
- ☐ Product improvement
- ☐ Replacement of inadequate equipment, tools, or materials
- ☐ Plant or process modernization
- ☐ New plant
- ☐ Energy conservation
- ☐ OSHA conformance
- ☐ EPA conformance
- ☐ Metrication
- ☐ Other:_____

Date:_____

Stage 2

Steps to Solutions

Check actions that will be necessary

- ☐ Production cost analysis
- ☐ Parts or process quality analysis
- ☐ Plant or dept. capacity analysis
- ☐ Process or methods comparisons
- ☐ Product design review
- ☐ Materials evaluation
- ☐ Make vs. buy review
- ☐ Plant services review
- ☐ Manpower review

Stage 3

Evaluating Approaches

PLANT CAPACITY STUDIES
- ☐ Add floor space
- ☐ Add work shift
- ☐ Increase process output
- ☐ Build new plant
- ☐ Add more people
- ☐ Add more overtime
- ☐ Increase efficiency of floor space
- ☐ Other:_____

PROCESS OR METHODS COMPARISONS
- ☐ Change process or method
- ☐ Modify present process or method
- ☐ Add more of same units
- ☐ Replace units with same
- ☐ Other:_____

PRODUCT DESIGN REVIEW
- ☐ Change tolerances
- ☐ Alter configuration
- ☐ Change structure
- ☐ Change component
- ☐ Other:_____

MATERIALS EVALUATION
- ☐ Change alloy
- ☐ Change kind of material
- ☐ Alter shape or size
- ☐ Alter condition of material
- ☐ Change vendor
- ☐ Other:_____

MAKE VS. BUY REVIEW
- ☐ Make new parts
- ☐ Make more parts
- ☐ Make less parts
- ☐ Buy new parts
- ☐ Buy more parts
- ☐ Buy less parts
- ☐ Change vendor
- ☐ Other:_____

PLANT SERVICES REVIEW
- ☐ Check supplies of air, power, gas, etc.
- ☐ Check available floor space
- ☐ Is material handling adequate?
- ☐ Are toolroom facilities adequate?
- ☐ Is maintenance force current with technology?
- ☐ Other:_____

MANPOWER CONSIDERATIONS
- ☐ Number of people needed (by skills)
- ☐ Supervisory force competence
- ☐ Additional training requirements
- ☐ Organization structure

Stage 4

The "Justifying"

If you are going to a new process or new equipment, note the impact of any of the following on your proposed change. Then, wherever possible, estimate the dollar gain or cost of the factor. Use the total to help justify your proposed action, and to compare it with the present or alternative methods.

- ☐ Inventory*
- ☐ Direct labor**
- ☐ Indirect labor**
- ☐ Fringe benefits**
- ☐ Tooling (including new tools for greater productivity)
- ☐ Maintenance (including where necessary training for new equipment)
- ☐ Supplies (compressed air, lubricants, coolants, welding wire, etc.)
- ☐ Floor space (plus air space over the equipment)
- ☐ Power (electricity, gas, etc.)
- ☐ Downtime (anticipated maintenance plus tool change and adjust, inspection, etc.)
- ☐ Scrap and rework (including cost of handling scrap)
- ☐ Taxes, insurance and depreciation
- ☐ Subcontracting
- ☐ Lease vs. buy
- ☐ Equipment flexibility (for product mix or future design change)
- ☐ Material handling
- ☐ Materials costs
- ☐ Elimination of assembly or other secondary operations
- ☐ Availability of equipment service
- ☐ Availability of replacement parts
- ☐ Equipment standardization
- ☐ Enhanced product value
- ☐ Lead time
- ☐ Attitudes of supervision and operators (productivity, absenteeism, etc.)
- ☐ Effect of project on other operations
- ☐ Warranty costs
- ☐ Field product service costs
- ☐ OSHA conformance (safety, noise, illumination, etc.)
- ☐ EPA requirements (air, water pollution, waste disposal, etc.)
- ☐ Metrication
- ☐ Other equipment needed (cranes, elevators, lift trucks, etc.)
- ☐ Salvage value
- ☐ Other:_____

*Inventory is not a cost. It is a capital asset and can be subtracted directly from the cost of the project. See PRODUCTION, July, 1971, page 53.

**All labor costs should include projections for known or anticipated increases during the payback period.

Stage 5

Listing the Alternatives

Based on your work to this point, use the total installed cost, including the price of the equipment, foundation, pit, basement, ancillary equipment, startup costs, etc., to calculate a Return on Investment or payback period.
If the ROI or payback period meet your company's requirement, then prepare a proposal for approval and funding.
After authorization:

Request Bids or Prices for a Specific Type of Product
- ☐ List acceptable sources
- ☐ Suggest acceptable alternate sources
- ☐ Other:_____

Request Proposals for a Specific Job or Project
- ☐ List acceptable sources
- ☐ Suggest acceptable alternate sources
- ☐ Other:_____

Visit Vendor Plants
- ☐ List plants to be visited
- ☐ Suggest acceptable additions
- ☐ Other:_____

Discuss with Supervision, Maintenance, Operators
- ☐ Explain new concept and benefits
- ☐ Discuss training and skills needed
- ☐ Show impact (if any) on status quo
- ☐ Make sure efficiency estimates are right
- ☐ Other:_____

Date(s):_____

Stage 6

Project Proposal

- ☐ Evaluate bids or alternatives
- ☐ Select vendor(s)
- ☐ Propose purchase
- ☐ Other:_____

Date to be completed:

_____

Date(s):_____

Stage 7

Purchase Procedure

- ☐ Approve purchase

and

- ☐ Issue purchase order

Date(s):_____

Stage 8

Into Production

- ☐ Delivery

_____

- ☐ Installation complete

_____

- ☐ Accepted for production

_____

Acceptance Date(s):_____

Stage 9

Post Audit(s)

- ☐ Is it producing as anticipated?
- ☐ Is quantity adequate?
- ☐ Is quality adequate?
- ☐ Are costs in line?
- ☐ Other:
- ☐ Corrective action required

_____

_____

Corrections made, or performance verified.

Date:_____

The Evolution of a Project above is meant to be a guide to help you in your management of change in your company or plant. No single plan will work for all; alter it and tailor it to best meet your needs. If you can suggest ways to improve it and make it more useful, please send your ideas to: Editor, PRODUCTION, Box 101, Bloomfield Hills, Mich. 48013

If you'd like to use the above outline for planning, you can get 10 worksheets for $1.00 by writing to PRODUCTION.

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This means that with the capacity crunch, most of the 1974 dollars will go for conventional equipment, components, and materials. And, despite the relatively modest showing of government mandates on capital spending (see p. 24), a large number of dollars will go into OSHA- and EPA-related equipment. The manager of production engineering at one large plant says that more than 70 percent of his spending this year will be to meet government requirements. That's an extreme case, undoubtedly, but, nonetheless, there go some dollars that could have gone into manufacturing innovation.

When can you innovate? Of course, every project contains some innovation, even if it's unconventional tooling in a standard machine, or a switch in materials to eliminate heat treating. But the real quantum jumps in innovation come when you have both the time and the management support to find the best possible way to do a job, not just the one you can turn on the quickest.

At the Round Rock (Tex.) plant of Westinghouse Electric Corp., for example, Gordon C. Hurlbert, vice president, admitted: "We took substantial risks when we designed this plant and the equipment it would use . . . We went beyond the 'state of the art' in heavy manufacturing." (See PRODUCTION, April, 1973, to see how far they went.)

At Round Rock, some equipment now at work will set the standard for similar operations for years to come. The plant is the result of tens of thousands of engineering and planning manhours on the part of the company and its suppliers. The goal, which now looks reasonable as the production progresses: "We expect to become the low-cost producer in the (gas turbine engine) business. For instance, we expect to reduce the labor content of our product by a third and also cut the manufacturing cycle time by a third."

First, Define The Task. That's the advice of David H. Russell, sales engineer, Ingersoll Milling Machine Co., Rockford, Ill. According to Russell, the following are considerations to be made in technically defining what is to be done:

First, check the part design. Group families, if any (size, type, material). Determine part characteristics that are most likely to undergo design changes. Specify material details (hardness, chemistry, surface conditions, metallurgy, etc.). Then establish initial locating points where applicable.

Second, identify critical dimensions. Establish how they are to be inspected (what type of gages) and analyzed (100 percent inspection or statistical sampling). Review the design to ensure that the drawing is complete (are surface finish, flatness, roundness, taper, etc., specified?). Determine what the accuracy capability test and acceptance requirements will be.

Third, determine total volume forecasts by year, with estimated accuracies of the forecasts. Specify production mix forecasts by year with estimated accuracies. Identify hourly production rate flexibilities required to meet forecasted volumes.

Fourth, if it's new equipment that is being considered, establish an "envelope" size needed to allow for future product changes.

Fifth, identify performance levels of current systems or equipment, unless your project is for a brand new product. Check labor requirements, product scrap and repairs, maintenance, perishable tool usage and change frequency, change-over times, net parts produced per hour or day, cycle rates. Identify specific problem areas and their causes. Identify specific performance improvements required.

Sixth, consider the parts' material, form, critical tolerances, locating and clamping points, where relevant. Relative to compatibility with various manufacturing processes, perhaps product design changes could considerably reduce manufacturing complexity and cost.

Find the Opportunities. Assuming you have the chance to look for changes to improve production, and that you're not under the gun for time, how do you go about finding the good potential projects? Westinghouse's Burnham says: "In our cost-improvement efforts, which translate into productivity-improvement efforts, we repeatedly ask ourselves the same three questions:

"First, can it be eliminated?

"Second, can it be combined with another unit?

"Third, can a simpler unit be substituted?

"This is the kind of approach that industrial engineers have used for years in bringing about greater productivity in factories. Entire job operations are broken down into their basic components —eventually down to physical movements of the body, arms, and even fingers. Each of the basic units is analyzed, eliminated, combined, or improved where possible and then reassembled into an improved overall procedure."

Do It Different. When you're working on your plan for improvement, don't settle for the information in the catalogs you've had for five years. Reach out for something new. It was with considerable disappointment that an automaker told PRODUCTION: "We have made changes and improvements, but basically, our plants, equipment, and processes look pretty much like they did 20 years ago."

For a manufacturing engineer, that kind of dissatisfaction is healthy. He ought not to be satisfied with any of his operations. He ought to be challenging them all. For example, if you use transfer lines, have you considered the possibility of suspending the line overhead? Parts could be gripped and moved along the "upside-down" line, chips falling out of, instead of into, the machinery, transfer mechanism, and fixtures. The entire plant floor could be used for storage and transfer of production. Sound far out? It is, but at least one company is giving

it some thought.

Or what about laser welding? It's in the wings, being tested. Or could you injection mold some plastic between two mating parts, so the plastic both locates and holds the parts—no other fasteners? That's being done in production every day (PRODUCTION, January, 1973, p. 67). Or replace some tough-to-locate fasteners with adhesives.

Innovation with the technologies that are already here, just waiting to be applied, could permit you to justify change that no mere replacement ever could. However, when you find a new technology you can use, your job is just starting. Frank Daley, director of manufacturing development, Manufacturing Staff, General Motors Corp., told PRODUCTION: "In forecasting the probable consequences of new technology, we need to recognize that one of the probable consequences is that the available technology might not get used at all . . . unless we generate good, thorough preparation beforehand."

One production engineer recently lamented: "Hell, I do three times as much selling on a plan as any of the salesmen who call me. First, I have to sell myself that the project is worth the time and grief it's going to cost me. Then I have to convince my boss that the chance of improvement is worth my spending time on it. I have to sell some associates on helping me in product design, plant engineering, or production management. I have to sell the hourly men that I am not putting their jobs in jeopardy. Then I have to sell some suppliers on helping me do it my way. And finally, I have to come up with a sales piece (proposal) that will convince management the investment is worthwhile. Then, if that's bought, I have to go back to the production workers, maintenance men, and everyone else affected and sell them on the advantages of the change both for the company and for them. I sometimes wonder what I'm doing with my engineering degree."

Three Tips. First, your manufacturing plan, both immediate and long range, must begin with your company's marketing plan. If a product is to be phased out, or a new one introduced, or some new models added to the line, or capacity to be expanded . . . those plans and their timing must have a direct effect on your manufacturing plan.

Second, when you have made a plan on what your production equipment and processes really should be five years from now, don't expect to sell the whole package. If you have a master plan, at least you know the direction you should be taking, and you can break it up into manageable and palatable projects.

There is a third suggestion, in reference to the checklist of areas for savings (below). If you convince your financial people to permit it, don't consider projected inventory reductions as savings. Inventory is a capital asset, and it should be subtracted from the price of the equipment you plan to buy. Thus, if a $200,000 program will save $25,000 in inventory, you should have to justify only $175,000 with cost reduction. Several large companies are now using this approach, and it can make a marginal proposal look like an excellent one.

The chart, (see folded insert) is designed to help you work out your own procedures. It has been viewed by several hundred manufacturing men who say it represents a logical and realistic route from beginning to end. The checklist on p. 22 is to help you in your search for benefits that might help you justify your proposal.

If additional information would be helpful in your planning, write: Editor, PRODUCTION, Box 101, Bloomfield Hills, Mich. 48013. ■

Here are the questions management at one large corporation asks those who are seeking an appropriation for new equipment.

APPROPRIATION CHECKLIST

	YES	NO	N/A
I. BUSINESS PLAN			
1. Is project consistent with Profit Plan and Company's strategies relative to:			
• Engineering Design and Development?			
• Market forecast (a) Volume?			
(b) Timing?			
II. COMPANY'S CONSIDERATION OF ALTERNATIVES			
1. Were "make or buy" alternatives carefully evaluated?			
2. Were systems of key competitors known and considered?			
3. Was state of the art in terms of manufacturing technology for this project fully evaluated?			
4. Were alternatives of "purchase new," "repair existing," "surplus list," and "used equipment" analyzed?			
III. REVIEWER'S EVALUATION OF PROJECT OBJECTIVES AND PLANS			
1. Is project a step toward low-cost producer?			
2. Is the load plan for the facility well thought out?			
3. Is duplication of Corporate facilities justified?			
4. Is project coordinated with prior and following plans or processes?			
5. Has impact on People been planned?			
6. Have environmental Factors been Planned? (a) Safety? (b) Pollution? (c) Noise or other?			
7. Have inventory effects been planned?			
8. Is project coordinated with the manufacturing information system?			
9. Are services planned (tools, power, handling, etc.)?			
10. Is project within division's present capabilities?			
IV. RECOMMENDATIONS			
1. Should be reviewed by others Hdqtrs. Functions? INDICATE:			
2. Confidence in figures? (a) Appropriation expenditure estimate			
(b) ROI			
3. Recommend Approval			
V. REMARKS:			

In facilities improvement, ARE YOU KEEPING UP?

Planning for a company's long-range future is believed to be weaker in the manufacturing area than in the marketing area.

And the shortages that started developing last year and are intensifying as this year gets under way indicate that much of industry's planning is extremely conservative and tends to be short-range. Under these circumstances, unexpected external factors have magnified impact, throwing the plan further out of whack. This is clearly seen today in industry's inability to cope adequately with the energy shortage, with its resultant intensification of materials shortages that had already reached serious proportions. Had these two situations not emerged, however, industry would have been considerably hampered in its operations this year by manpower shortages.

The emphasis on short-range planning and the need for "crisis" response to unexpected developments also is intensifying the inflation, and changing it to a classic demand-pull type with too many dollars chasing too few goods.

In retrospect, most companies now wish that two and three years ago they had had the courage—or the cash—to buy the equipment they needed last year and hope they'll continue to need this year. But "hoarding" of equipment against a "some time" need or modernizing at an especially propitious time instead of waiting for the time when expansion becomes mandatory are actions that cash-flow-conscious top managements have not encouraged. They're "paying the piper" literally and figuratively this year.

How low industry's expenditures for capital equipment sank in 1971 and how high they're expected to rise in 1974 are shown below.

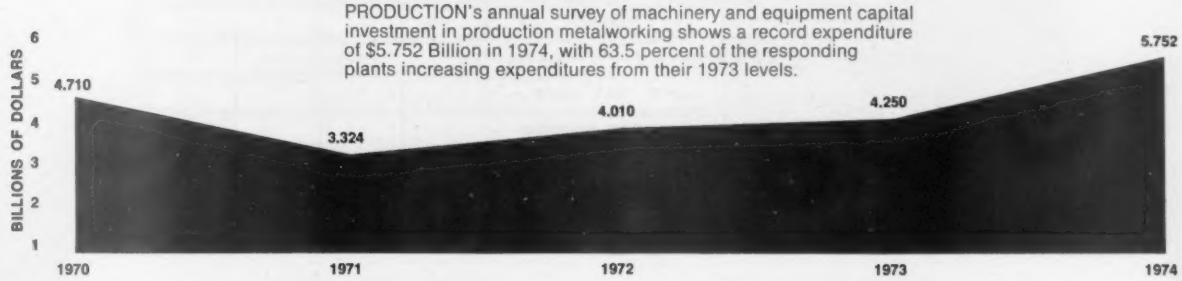
These figures are obtained from the survey conducted annually by Bramson Publishing Co.'s vp-research, Edward D. McCallum, Jr., for use in PRODUCTION and in the MANUFACTURING PLANBOOK.

The production metalworking industries* are projecting a record investment in machinery and equipment of $5.752 billion in 1974, up 35.4 percent from the 1973 spending plans, 43.4 percent above the 1972 projection, and 73 percent higher than budgeted for 1971.

*Considered for the purpose of this survey to be plants reached by PRODUCTION Magazine in: Metal Furniture (SIC 25), Fabricated Metal Products (SIC 34), Machinery, except Electrical (SIC 35), Electrical Machinery (SIC 36), Transportation Equipment (SIC 37), Instruments (SIC 38) and Miscellaneous Manufacturing (SIC 39).

Machinery-Equipment Expenditures up 35.4% over 1973

PRODUCTION's annual survey of machinery and equipment capital investment in production metalworking shows a record expenditure of $5.752 Billion in 1974, with 63.5 percent of the responding plants increasing expenditures from their 1973 levels.



Here's How 20 Different Industries Allocate Their Capital Equipment Dollar

	SIC 342		SIC 344		SIC 345		SIC 346		SIC 352		SIC 353		SIC 354		SIC 355		SIC 356	
	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
METAL CUTTING MACHINES	22.9%	20.5%	9.6%	6.6%	52.9%	52.8%	11.9%	11.1%	17.3%	21.5%	49.9%	44.8%	68.8%	71.7%	56.0%	57.9%	53.7%	56.4%
METAL FORMING MACHINES	17.4	19.7	24.1	27.9	19.2	16.0	47.2	48.1	33.0	20.3	12.7	15.3	7.8	9.1	15.8	13.3	10.0	11.6
ASSEMBLY EQUIPMENT	20.8	18.9	11.4	13.2	2.9	6.8	11.1	7.5	8.0	5.9	5.8	5.1	3.3	3.7	4.6	4.2	6.1	7.8
MATERIAL HANDLING EQUIPMENT	7.1	8.1	11.6	13.8	7.9	4.6	4.8	6.9	13.1	16.9	7.1	9.3	3.0	3.9	7.4	6.5	6.3	6.2
CLEANING/FINISHING EQUIPMENT	6.1	11.9	10.4	8.6	3.1	5.8	6.9	6.8	8.6	12.3	5.7	3.8	2.9	1.9	3.3	0.8	3.6	4.2
WELDING	1.5	3.7	14.9	11.7	0.2	1.0	4.1	3.9	7.5	10.9	7.5	9.9	1.9	1.4	2.9	7.4	4.1	3.8
PLASTIC MOLD-FORM EQUIPMENT	3.6	4.2	1.8	1.6	2.4	1.0	5.2	1.9	–	0.5	–	1.2	1.5	1.3	0.2	3.0	1.1	0.4
HEAT TREAT EQUIPMENT	3.4	4.4	2.0	0.4	3.2	3.4	1.1	2.7	1.4	3.2	4.7	2.8	5.1	2.3	2.1	0.9	4.7	1.6
PACKAGING MACHINES	3.5	1.7	1.5	0.5	2.7	5.3	1.6	1.4	1.6	2.6	–	–	0.8	0.3	0.2	1.3	0.9	0.5
ALL OTHER	13.5	8.6	12.6	15.8	5.5	3.3	6.1	9.7	9.3	5.8	6.6	7.8	4.9	4.3	7.7	4.7	8.5	7.5

SIC 342 — Cutlery, Hand Tools, Hardware
SIC 344 — Fabricated Structural Metal Products
SIC 345 — Screw Products
SIC 346 — Metal Forgings & Stampings
SIC 352 — Farm and Garden Machinery
SIC 353 — Construction and Material Handling Equipment
SIC 354 — Metalworking Machinery
SIC 355 — Special Industry Machinery
SIC 356 — General Industrial Machinery & Equipment
SIC 357 — Business Machinery

The 1974 figure, it bears noting, was projected from the responses from the 9,500 plants contacted in the survey; the respondents answered the survey prior to President Nixon's television address on the energy situation. To assess the effect of energy shortages on spending plans after that speech, a cross-section of plants subsequently was contacted and they reported no curtailment of their spending programs. It is likely, however, that some change in equipment "mix" will take place.

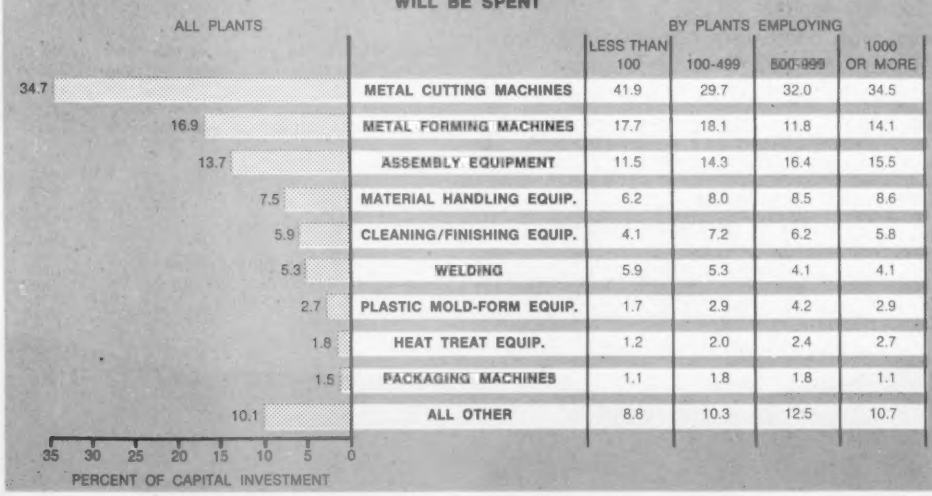
The planned 1974 mix of expenditures vs. the 1973 mix in nine equipment categories and in 20 key industries is presented in charts on this and the facing page to enable readers to check their own companies' planned machinery and equipment investment mix against that of their industry as a whole. A reader finding that his company's planned investment in assembly equipment, for example, is a substantially different proportion of its total approved expenditures than the industry's pattern may want to further investigate where competitors are putting their spending priorities.

Key Spending Reasons. With more plants operating at close to their practical capacity, it is not surprising that increased capacity is the primary motive behind the 1974 equipment investment plans, with 46 percent of the respondents giving this as their No. 1 objective.

However, when the figures for first-place and second-place objectives are combined, cost reduction becomes the major motive for the production metalworking industries' 1974 spending.

Fewer plants than last year—13 percent vs. 15.6 percent—cited government regulations (chiefly EPA and OSHA) as their primary or secondary motive for 1974 spending. This could be taken to mean that most of the "crash" projects to meet government's environmental and safety mandates now are behind

HOW THE 1974 CAPITAL EQUIPMENT DOLLAR WILL BE SPENT



	BY PLANTS EMPLOYING			
	LESS THAN 100	100-499	500-999	1000 OR MORE
METAL CUTTING MACHINES	41.9	29.7	32.0	34.5
METAL FORMING MACHINES	17.7	18.1	11.8	14.1
ASSEMBLY EQUIPMENT	11.5	14.3	16.4	15.5
MATERIAL HANDLING EQUIP.	6.2	8.0	8.5	8.6
CLEANING/FINISHING EQUIP.	4.1	7.2	6.2	5.8
WELDING	5.9	5.3	4.1	4.1
PLASTIC MOLD-FORM EQUIP.	1.7	2.9	4.2	2.9
HEAT TREAT EQUIP.	1.2	2.0	2.4	2.7
PACKAGING MACHINES	1.1	1.8	1.8	1.1
ALL OTHER	8.8	10.3	12.5	10.7

SIC 357		SIC 358		SIC 359		SIC 362		SIC 363		SIC 365		SIC 367		SIC 371		SIC 372		SIC 382		SIC 386	
1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974	1973	1974
22.6%	28.3%	15.1%	17.3%	62.2%	65.7%	25.9%	37.1%	5.0%	4.0%	8.7%	17.5%	8.7%	9.7%	30.3%	30.2%	51.9%	54.5%	32.3%	41.1%	30.4%	36.9%
5.8	13.6	18.1	23.9	10.3	11.7	13.6	15.1	24.2	22.1	14.3	15.4	14.3	12.9	16.8	15.8	10.5	7.1	10.7	6.7	16.5	24.7
37.6	22.3	30.4	16.8	8.1	5.6	25.2	14.2	15.5	13.0	38.5	30.8	38.5	38.3	15.7	16.0	11.9	8.2	24.1	20.0	17.0	12.5
6.1	6.3	9.4	11.8	4.4	5.1	6.3	7.3	12.8	13.0	5.5	4.7	5.5	5.3	11.5	10.1	1.0	5.5	7.8	6.2	5.0	6.3
3.4	6.7	10.0	3.4	3.7	1.6	4.2	3.3	14.0	18.2	6.2	5.0	8.2	9.7	6.6	3.3	5.3	7.5	4.5	9.1	17.0	3.0
1.7	2.9	11.1	10.0	3.7	4.4	4.2	3.9	4.8	2.0	2.8	3.8	2.8	4.2	5.7	7.6	2.3	1.4	4.8	2.6	4.0	5.9
2.7	0.5	4.5	1.8	1.2	0.1	3.6	4.7	13.9	6.2	5.0	2.3	5.0	5.7	1.1	1.0	–	1.9	4.1	5.0	–	–
2.9	1.0	–	–	0.2	1.4	0.8	1.0	1.2	2.7	–	–	0.3	1.8	1.6	4.4	3.6	6.1	1.5	0.9	–	–
0.8	1.9	2.2	0.8	2.2	0.6	1.5	1.0	3.2	4.5	1.8	1.2	1.8	2.8	1.1	1.1	–	1.9	1.0	2.6	2.5	–
15.4	16.6	9.2	14.1	3.9	3.8	14.5	12.3	5.4	14.3	15.2	19.3	14.9	9.6	8.3	10.7	13.5	5.9	9.2	5.8	7.5	10.7

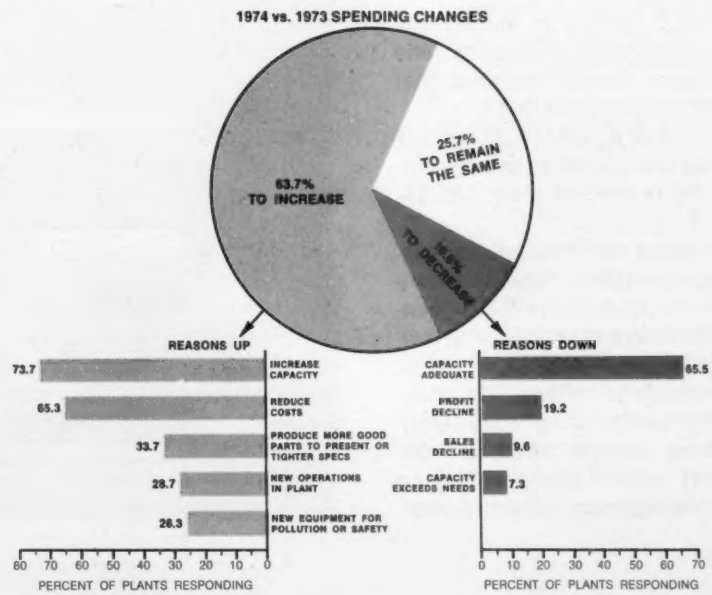
Refrigeration and Service Industry Machinery (SIC 358)
Miscellaneous Machinery, Except Electrical (SIC 359)
Electrical Industrial Apparatus (SIC 362)
Household Appliances (SIC 363)
Communications Equipment (SIC 366)
Electronic Components & Accessories (SIC 367)
Automotive (SIC 371)
Aircraft & Parts (SIC 372)
Measuring & Controlling Instruments (SIC 382)
Photographic Equipment & Supplies (SIC 386)

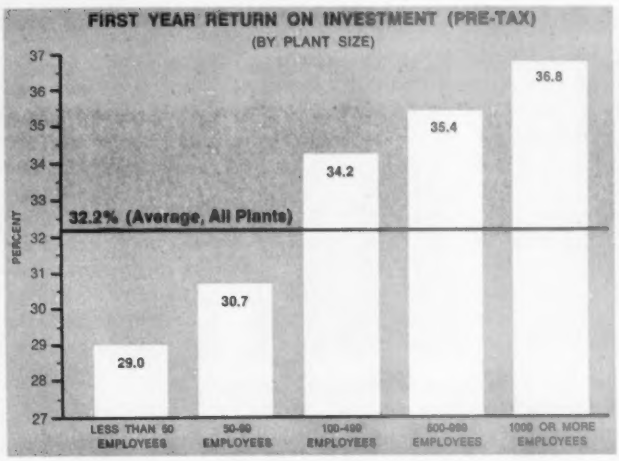
the responding plants. However, on the basis of personal contacts with many major plants, such does not seem to be the case; heavy expenditures in this area still need to be made. Instead, it seems likely that the expansion/cost-reduction motives have increased in importance, while the mandated improvements now are being put in place on a planned basis, and they no longer have the extreme urgency they had last year.

The fact is that 63.7 percent of the responding plants say they will increase their 1974 capital spending (vs. 61.9 percent last year, which, incidentally was 14.5 percentage points higher than the group which increased their spending for 1972). This indicates that more plants are going after "wanted" improvements/expansions as well as "needed" facilities.

And perhaps an even higher percentage of plants would be increasing their expenditures if many were not bumping up against serious shortages of manpower or raw materials supplies. In explaining why their operations were not at capacity in 1973 (average operating rate was 84.1 percent vs. 79.1 in 1972), 58.6 percent of the respondents said manpower shortages limited their ability to increase operations, 53.4 percent were experiencing shortages in parts and materials, 16.4 percent were running into excessive equipment maintenance problems, and 23.1 percent were troubled by lagging sales.

The 10.5 percent of respondents whose equipment and machinery investments will be smaller in 1974 than they were in 1973 (up 1.3 percentage points from the number whose spending was being decreased in 1973 from the previous year) cite these reasons for their curtailment: adequate machine capacity (65.5%), profit decline (19.2%), and sales decline (9.6%).


1974 vs. 1973 SPENDING CHANGES
63.7% TO INCREASE
25.7% TO REMAIN THE SAME
10.5% TO DECREASE
REASONS UP
73.7 INCREASE CAPACITY
65.3 REDUCE COSTS
33.7 PRODUCE MORE GOOD PARTS TO PRESENT OR TIGHTER SPECS
28.7 NEW OPERATIONS IN PLANT
26.3 NEW EQUIPMENT FOR POLLUTION OR SAFETY
60 70 60 50 40 30 20 10 0
PERCENT OF PLANTS RESPONDING
REASONS DOWN
CAPACITY ADEQUATE 65.5
PROFIT DECLINE 19.2
SALES DECLINE 9.6
CAPACITY EXCEEDS NEEDS 7.3
0 10 20 30 40 50 60 70
PERCENT OF PLANTS RESPONDING



The general loosening-up of purse strings for equipment procurement is manifested in the reduction in companies' return-on-investment objectives. Average minimum first-year R-o-I for equipment will be 32.2 percent in 1974, down from 33.9 percent in 1973. Larger plants (those employing 500 or more) continue showing a larger justification requirement—36.2 percent.

"The Big Spenders." There are some interesting differences between those plants that will increase their equipment spending in 1974 and those that will hold to the 1973 level or reduce it.

First, these plants, on the average, will spend 2.3 times as many dollars for equipment as the "hold-the-line" plants. Yet, they have a higher first-year R-o-I requirement than the average respondent—33.4 percent vs. 32.2 percent.

Second, they operate 68 percent of the computers and mini-computers used for controlling/monitoring production machinery of the total reported by survey respondents, and they will account for 73 percent of the planned purchases of such devices in the next 24 months.

Third, they operate 70.6 percent of the NC machine tools in use by respondent companies, and they'll buy 72.6 percent of the NC machines that the respondents say are budgeted for 1974.

Fourth, they're operating at a higher average rate than the companies that will maintain their investments at the 1973 level or reduce them (85.1% of capacity vs. 82.4% of capacity).

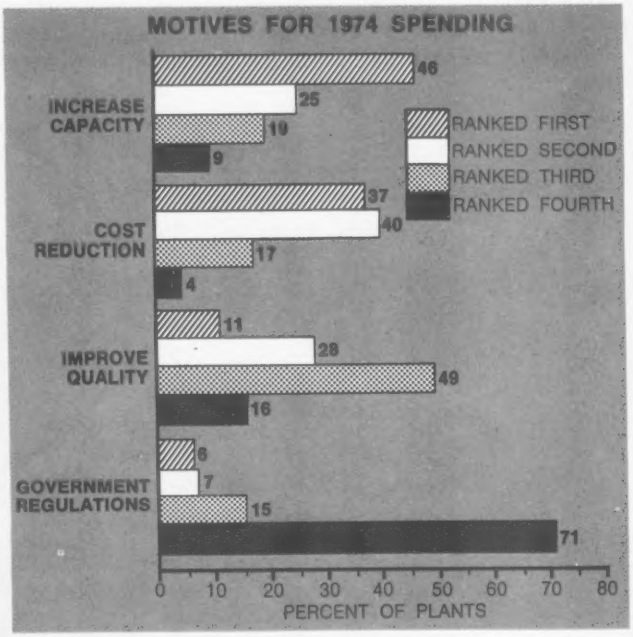
The National Commission on Productivity suggests that multiple-plant companies could substantially improve their over-all productivity if they concentrated on their plants where productivity is lowest, bringing them up toward their best plants' performance. This procedure is followed by many companies where staff manufacturing consultant/audit teams are searching out the differences between "best" and "worst" plants and encouraging the internal transfer of management expertise and/or equipment performance know-how to bear on the laggard plants' performance.

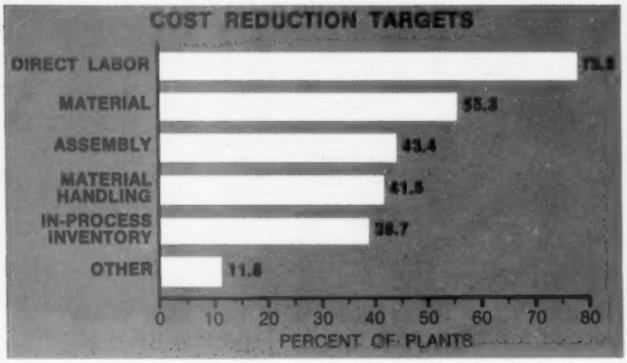
It is an oversimplification to suggest that a plant which spends more for equipment is automatically a "better" plant, or that those operating NC equipment and computer-run machine tools are, *per se*, superior. This comparison omits differences in products, profitability, and other key distinctions. However, for the man trying to find ways of improving his own operations' capabilities, it should be fundamental to look at what his "sister" plants are doing as a starting point and then to analyze as completely as possible what's being done in outstanding plants whose operations/products are similar to his own.

What They're Looking For. The companies that are increasing their equipment spending in 1974 are aiming, primarily, at increasing their capacity (73.7%); buying new machines to reduce costs (65.3%); improving the quantity of good parts produced to present or tightened specifications (33.7%); putting new operations in their plants for parts formerly procured from the outside (28.7%); and adding pollution control/safety equipment/facilities (26.3%).

Looking a little deeper into the motives for their spending by all the responding plants (not just those increasing their investments in 1974), the survey shows the following as the major avenues being taken toward optimizing cost-quality-capacity:

- Rearranging operations to shorten supply lines, reduce material handling, and cut in-process inventory (60.9%);
- Adopting processes/machines/materials that minimize process requirements (40.3%);





- Performing operations previously done outside (38.1%);
- Setting up computerized production control systems (29.7%);
- Establishing separate production areas to handle special or low-volume jobs, service parts, special orders, etc. (29.7%);
- Purchasing from outside sources parts/products previously produced in-house to augment capacity (20.8%).

The percentage of companies bringing more work into their plants (38.1%) continues in a steeply downward trend for the third year, indicating that consolidations are for the most part behind these companies and that machine capacity and floor space limitations won't permit much more of this approach toward optimizing costs-quality-capacity. Last year's figure of companies taking this approach was 48.8 percent, and 1972's figure was 51.8 percent.

It is significant that as compared with the over-all figure of 29.7 percent of the responding plants which are going the computerized production control route, the percentage rises to 47 percent among plants employing 500 or more persons and to 33 percent in the 100-499-person plants. Also worthy of note is that 11.2 percent of the responding companies say they are reconstituting some of their production line jobs to add variety to the work and reduce boredom. A higher percentage (17.5%) says they are setting up new or different incentive systems.

Reduction of direct labor continues to be the major cost-reduction target of the responding plants, as it has been since 1971. It is cited by 75.8 percent, a 6.8 percentage point drop since last year. Reducing the cost of materials is getting increased attention now, and 55.3 percent of the responding plants (up from 49.6 percent last year) list this as a major objective. Reducing assembly costs and reducing material handling costs are cited by similar proportions of the responding plants as major 1974 objectives—respectively, 43.4 percent and 41.5 percent.

Where the Bucks Will Go. Significant shifts in the allocation of equipment dollars for 1974 as compared with 1973 are noted:

- Metal cutting machine tools continue to improve their share of the capital spending dollar from 32.9 cents last year (29.6 cents in 1972) to 34.7 cents in 1974, with most of the increase coming in plants employing 500 persons or over;
- Metal forming machine purchases as a percentage of the total will increase from 16.3 cents in 1973 to 16.9 cents;
- Assembly equipment is declining somewhat in the mix, taking 13.7 cents in 1974 from 14.6 cents in 1973;
- While plastic molding and forming equipment will drop from 3.1 cents to 2.7 cents of the average capital dollar in 1974, plants in the 500-1000-employee size are showing strong demand for this type of equipment;
- Spending for cleaning/finishing equipment is down from 6.4 cents last year to 5.9 cents in 1974, with major cutbacks being projected by automotive and hardware plants;
- Equipment for welding/riveting/brazing is up slightly (from 5.0 to 5.3 cents) with strong increased demand coming from hardware, construction machinery, communication equipment, electronic component, and automotive producers.

The survey this year looked at a new segment of material handling/automation equipment—universal transfer devices (UTDs, or, more popularly, industrial robots). Of the plants responding to the survey, 5.1 percent said they intend to buy UTDs in 1974. The interest is high across all industries, but the seven industry groups detailed below will account for better than half (53.8%) of the plants intending purchase. And 78 percent of the plants budgeting for UTDs have over 100 employees.

Percent of Those Plants Planning UTD Purchases

Automotive, including parts and accessories	12.9%
Metal forgers and stampers	12.9%
Electrical industrial apparatus (motor, generator, welding apparatus)	7.0%
Household appliance makers	5.8%
Cutlery, hand tools, hardware makers	5.8%
General industrial machinery (pumps, bearings, compressors, etc.)	4.7%
Heating and plumbing fixture producers	4.7%

Slightly more than one-quarter of the responding plants (26.6%) will be buying NC equipment in 1974. Significantly, the vast majority (77.8%) of the plants intending NC purchases already are NC users, and operate, on the average, 7.1 machines per plant. Of all the respondents, 32.1 percent currently operates NC equipment and averages 5.7 NC machine tools per plant.

This "typical" NC user and expander in 1974 is unusual in its over-all profile: It is operating at 85.7

PROJECTED 1974 CAPITAL EQUIPMENT INVESTMENT BY EQUIPMENT TYPE AND PLANT SIZE

	(percentages)							
	Less than 25 employees	25-49	50-99	100-499	500-999	1000+	(total $) (millions)	(1974 vs. 1973 %)
Metal cutting	0.5	5.2	10.4	34.7	11.2	37.9	$1,904.5	+36.2%
Metal forming	0.3	3.5	11.7	43.9	8.5	32.1	918.4	+32.7
Assembly	0.2	1.6	9.1	35.9	12.9	38.4	844.5	+35.9
Material handling	0.2	2.2	8.4	38.3	12.2	38.7	464.6	+51.8
Finishing	0.3	0.9	8.4	44.9	11.5	34.0	356.8	+31.2
Weld/Rivet/Braze	0.3	3.0	14.2	42.3	9.7	30.7	279.8	+31.7
Plastic molding	0.4	1.1	6.7	38.7	16.7	36.4	166.8	+26.6
Heat treating	0.2	1.4	6.3	35.0	12.6	44.5	127.0	+ 6.7
Packaging	0.4	1.1	8.9	47.8	14.3	27.5	83.8	+23.2
Other	0.3	2.2	9.3	37.7	13.7	36.8	607.4	+41.5
							$5,752.6	+35.4%

percent of capacity (against the average of 84.1 percent); it will spend almost $637,000 in 1974 for machinery and equipment; it allocates 57.2 percent of its capital investment to metal cutting machines and 11.1 percent to metal forming equipment; it is big (in seven out of 10 cases, it employs more than 100 persons); it will be buying more than one type of NC equipment.

There, however, is an upsurge in NC buying by smaller plants. Of the plants that will be buying NC in 1974, 24.5 percent employ less than 100 persons, up from the 18 percent in that size category that last year indicated plans to buy NC. Location of existing NC machines by plant size is indicated in this survey as follows: 10.3 percent in plants with under 100 employees; 38.2 percent in 100-499-person plants; 18.6 percent in 500-999-person plants; and 31.9 percent in 1000-and-over plants.

Of the NC buyers, 98.6 percent are in five industrial groups (SIC 34-38 inclusive). Plants in the Machinery, except Electrical, industry (SIC 35) lead in the percentage planning NC purchase (57.3%), followed by Electrical Machinery (SIC 36) with 14.1 percent NC-favorable response, Fabricated Metal Products (SIC 34) with 13.5 percent buying NC, Transportation Equipment (SIC 37) with 8.3 percent, and Instruments (SIC 38) with 5.4 percent. Metal Furniture and Miscellaneous Manufacturing account for the remainder.

The types of NC equipment to be purchased are depicted below with the percentage relating the equipment type to all plants indicating NC purchases in 1974: Turning equipment, 43.7%; Machining centers, 36.3%; Drilling machines, 25.3%; Milling machines, 22.2%; Boring machines, 13.9%; Punching machines, 11.9%; Profiling machines, 4.3%; Bending machines, 2.7%; Other types, including measuring, riveting, etc., 9.2%.

There's a strong correlation between the plants now operating NC equipment or planning its purchase in 1974 and plants currently using computer-controlled manufacturing equipment or planning its purchase.

Of the present plants with CAM (computer-aided manufacturing), 12.3% will add capability in 1974-1975. Of NC-oriented plants not currently equipped for CAM, 16.9 percent expect to develop some capability within the next two years. Current use of computers or mini-computers to control production equipment is reported by 7.4 percent of the survey's total respondents; 8.8 percent say they plan purchases of such equipment in the next two years. An additional 1.2 percent are considering use of such equipment but do not have it in their investment plans at this point.

Are You "On Target"? Each company/plant must, of course, decide for itself how much new equipment and of what types it needs and can afford. And looking at what "the other guy" is doing may be a way of compounding the frustration of a man who believes his company should be increasing its equipment spending.

Nevertheless, such activities as the United Fund are successfully based on a "fair share" concept; it's valuable to have the indication that averages can provide.

The two tables on this page provide opportunity for such a comparison. One shows average planned capital equipment expenditures in dollars by plant size; the other is a matrix of the 10 equipment/machinery categories against plant sizes where this equipment will be installed.

AVERAGE CAPITAL EQUIPMENT INVESTMENT

Plant Size	1974 Average $ per plant	1973 Average $ per plant
Less than 25 employees	$35,907 (+69.3%)	$21,210
25-49 employees	79,026 (+41.3%)	55,900
50-99 employees	114,098 (+68.7%)	67,600
100-499 employees	264,662 (+60.0%)	165,400
500-999 employees	411,146 (+11.9%)	367,500
1000+ employees	1,358,312 (+40.1%)	969,500

While these figures are presented primarily as a possible help to a manufacturing engineer/planner in looking at his own capital spending budget, they also should be useful to him in his capacities planning if his plant produces components or whole products of the capital-investment type. The percentages of increased demand for these 10 equipment/machinery categories, even after allowance for inflation, point to an intensification of the capital equipment boom if the materials, energy resources, and manpower to keep it rolling can be squeezed out of the nation's over-all economy. ■

Boosting Productivity:
Your No.1, Continuing Problem

The main subject on the minds of most readers of this PLANBOOK is Productivity. Almost as important is the equipment you use, which in reality, determines productivity. You have a realistic approach to such subjects as OSHA, metrication, and the energy crisis. You naturally are concerned about them, but your real problem is getting the goods out and at a profit. These other things are handicaps to that main objective so they figure into your current worries.

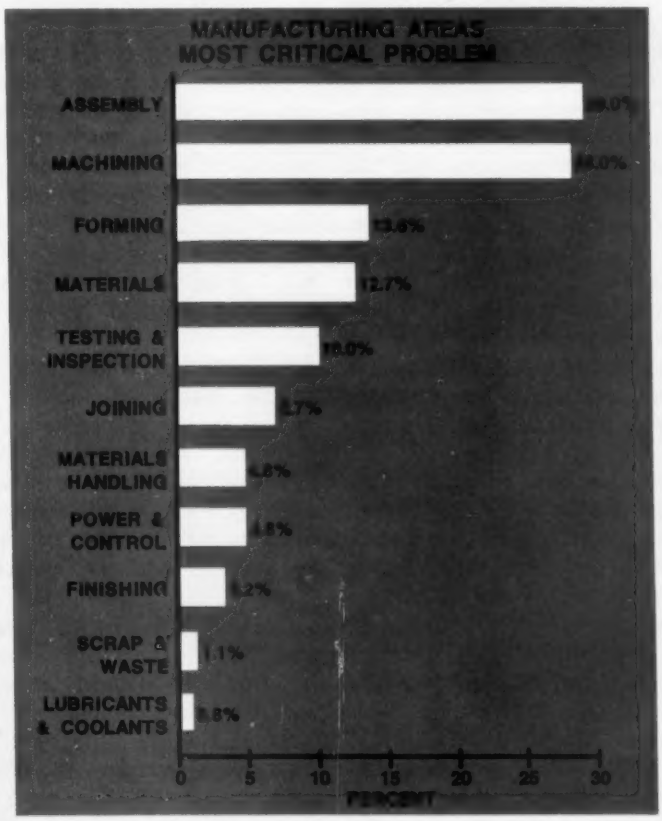
How do we, as editors of the PLANBOOK, know what you're thinking about? We've asked you! And what you have told us provides the raw material for this report.

Every reader of PRODUCTION Magazine was sent one of two survey forms for the MANUFACTURING PLANBOOK. The first form consisted of a very simple question: "What's the most serious manufacturing equipment or process problem facing you right now?" The second form was more complex and contained over 60 potential answers. Twice as many readers filled out the more complex form indicating a very strong willingness to share with us where your concerns are and what you're currently working on.

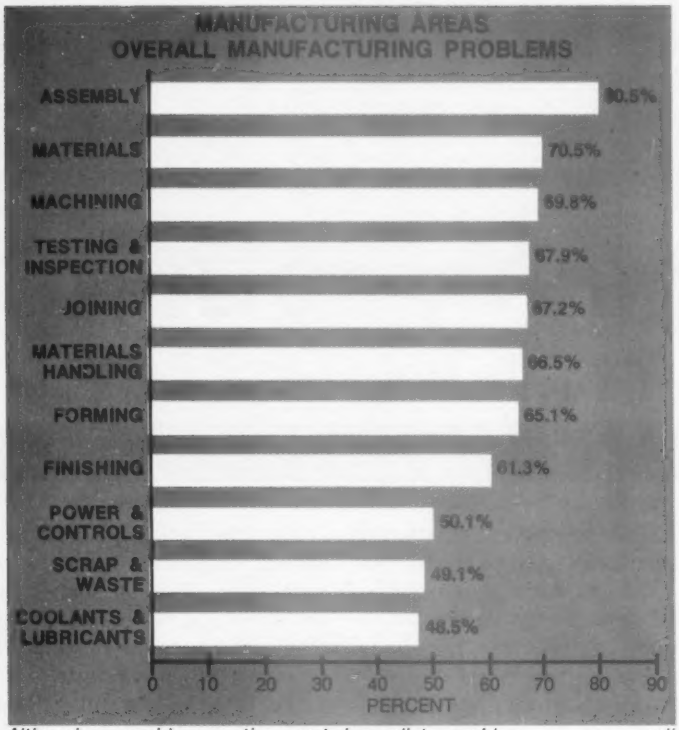
Without the two questionnaires, we would never have been able to develop a realistic picture of what problems plague our readers. For example, deburring was mentioned time and time again on the simple form. The long form gave us a better "handle" on the nature of the problem. Deburring problems show up on stainless, bronze, aluminum, and just plain steel materials . . . and part problems ranged from valve bodies to turbine blades for jet engines.

Many readers are puzzled over coating problems. They are concerned about powder coatings versus water soluble paints. Plating, cleaning, and fine finishing are mentioned frequently.

"For Want of a Nail . . ." Some problems are here today and gone tomorrow, but others stay indefinitely.



The assembly area is the manufacturer's most critical area. Actually, it was no surprise as this is where everything accumulates



Although assembly was the most immediate problem, on an overall basis, every area is critical

Almost universally, shortages are occurring everywhere. Long lead times, large inventories, substitutions and late deliveries are becoming commonplace. And the lead time and delivery problems are not limited to just materials. New equipment purchasers are in the same boat. Castings are in short supply and so are many electrical items. One copper manufacturing facility reported it has curtailed operations in half the plant because of the lack of scrap copper.

Many readers anticipated the energy crisis and say they expect the situation to get worse before it gets better. Other plants report that they have already established procedures to cope with this situation.

Some survey recipients are very dramatic in emphasizing their problems. "OSHA, MAINTENANCE, and SHORTAGES," written in red ink and underlined, is visible evidence of the seriousness of these problems.

To rank problems in order of importance is somewhat misleading. A shortage or late delivery is a problem until the material or machine is received. Others, such as productivity, personnel, and OSHA are continuous. Therefore, we asked on our survey for the No. 1 problem and for a list of what areas were of general concern.

In order of importance, assembly, machining, forming and joining appear to be the critical problems. Although not major problems, lubricants, and scrap and waste are minor irritants to many of our readers. The other five subjects mentioned, materials handling, materials, power and controls, and testing and inspection are continuous problems.

On an over-all basis, assembly was the major problem of our readers. However, the next five areas were separated by only 5 percentage points. They were materials, machining, testing and inspection, joining, and materials handling. Not much further down the line were forming and finishing.

- **Assembly**—The number one problem of the number one area is quality, with 55.4 percent of the respondents listing it as such. Trying to automate or increase the productivity of low-volume runs was particularly troublesome to many readers. Another problem area is downtime and maintenance. Especially important was the mentioning of ancillary items being down, such as when an air compressor failure can cause the whole line to go down.
- **Materials**—Over 50 percent of our readers report trouble with material availability and delivery. Since many manufacturers are substituting materials and processes to compensate for the shortage problem, a new problem has been created and that is quality. Manufacturers requiring castings are switching to steel stamping assemblies. Others are switching to plastics, and in some cases, they are dropping marginal product lines. Some manufacturers report they are standardizing on easily obtained sheet and plate sizes and redesigning their products to conform. Others that can't get high strength steels are changing the specifications for their product lines. As bad as it may seem, some manufacturers have gained by what they've been forced to do. In re-evaluating their products, they have made cost-saving substitutions.
- **Machining**—In the machining area, 44.2 percent of the respondents are experiencing problems with their tooling, especially with tool life. Finding capable machinists is becoming an increasing problem with many.
- **Testing and Inspection**—As could be expected, the quality of incoming material is deteriorating. Surprisingly, metrication was not rated highly as a problem. Those who did mention it, however, feel that conversion to metrics is going to be a costly affair.
- **Joining**—The bond between two

pieces of material joined together is not a major problem, but selecting the method to make the bond is. There were a variety of comments about bonding, with most concern expressed on epoxy bonding methods and soldering of electronic circuit boards.

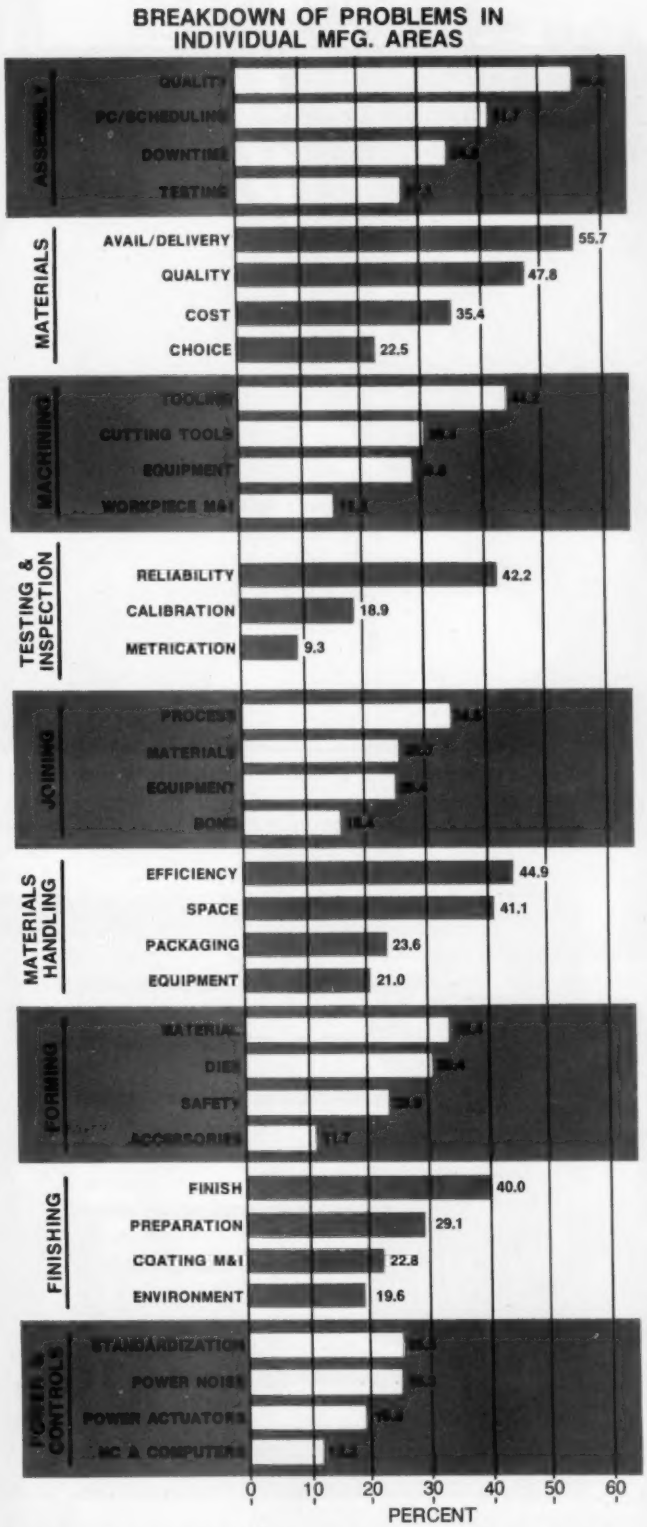
• **Materials Handling**—Efficiency of materials handling operations was listed by 44.9 percent of our readers as being critical followed closely by space limitations, which was 41.1 percent. Although not reported as a problem area, many readers stated that more savings could be obtained by improvements in materials handling than by any of the other areas mentioned.

• **Forming**—Materials, dies and tooling, and safety ranked highly in the problems listed for the forming category. Many production engineers are concerned about the effect of the energy crisis on operations requiring heat (such as forging operations). Some are investigating the switch from gas furnaces to induction heating of parts. OSHA's "no hands in the die" is a foreseeable problem by many.

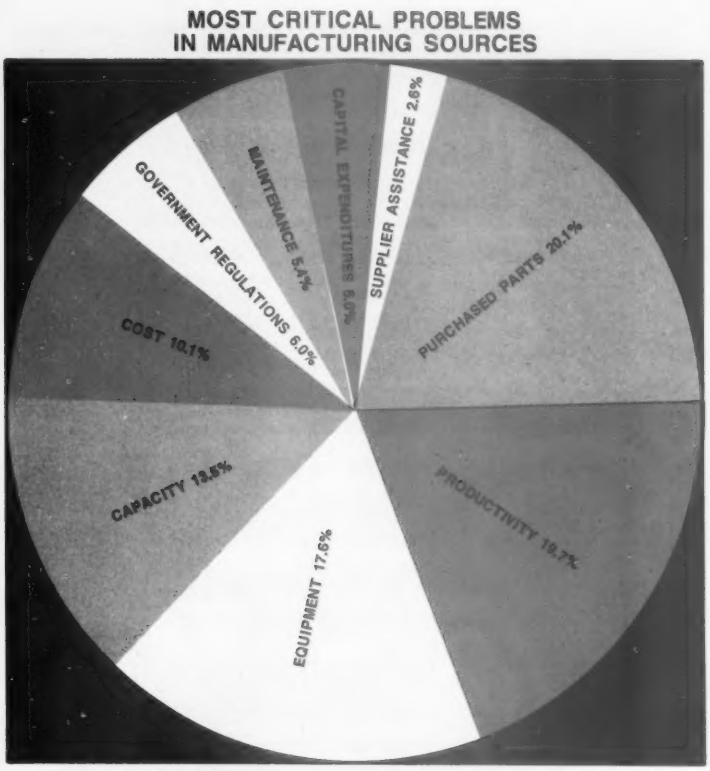
• **Finishing**—Finish quality leads the list of problems in this area. Close behind and related is surface preparation of the material. Many are investigating the use of pre-finished materials, and environmental problems are a concern to others.

• **Power and Controls**—Although listed by only 50.1 percent of the readers, power and controls are common to all equipment needs. Although many are interested in NC, CAD/CAM, mini-computers and programmable controllers, their major problems are standardization in the control area and noise in the power transmission area.

• **Scrap and Waste**—This is becoming an increasing problem since environmental laws are closing down many previous sources of disposal. No longer is indiscriminate material dumping allowed, and many companies are

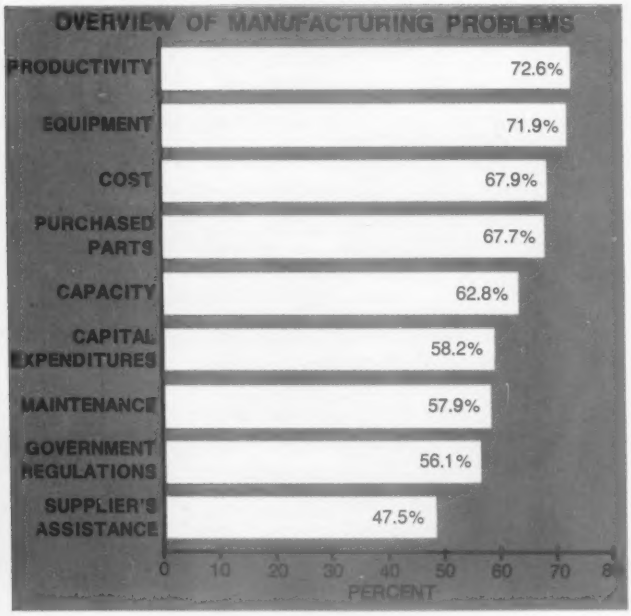


The importance of materials is quite evident. Not only is it the number two area of importance but it also shows its importance in the forming and joining areas



Criticism of suppliers is almost non-existent as a critical problem

On an overall basis, productivity is the key issue. Although governmental regulations are of concern to the manufacturer, they are not his major concern



looking for ways to reduce scrap as well as recycle materials. More efficiency in scrap handling methods is also under investigation.

• **Coolants and Lubricants**—This could become a sleeping giant. The energy crisis is cutting into the availability of petroleum products, and as one oil supplier told us: "If they (manufacturing plants) don't have a supplier lined up when they build a new facility, they won't be able to get hydraulic oils, etc., to start the place up."

Mutual Admiration Society? The second part of our reader survey covered the source of manufacturing problems. Was it management, government regulations, maintenance, etc.? Of comfort to most suppliers of industrial equipment, they were not listed as the main source of manufacturing executives' problems. Only 2.6 percent of our readers listed the supplier as his main cause for concern. However, this should not be misconstrued to mean that the supplier and user have a mutual admiration society as 47.5 percent of the respondents stated that they did have some problems with their suppliers.

Over-all, productivity was the major concern of the survey respondents, followed closely by equipment, cost, and purchased parts. Areas of least concern were maintenance, government regulations, and supplier assistance.

Productivity Is the Key. The results of our study indicate that productivity is what it is all about. Anything that will make an operation more efficient will be considered. We may be in a tight money market, but it is not that tight. Capital spending is at an all-time high in many industries (see p. 23).

Granted, superfluous spending is out, but was it ever in in manufacturing? Most manufacturing executives have always been concerned about capital expenditures. Probably the major difference between now and previous years is that they are more aware of the value received in the equipment they purchase. ■

INDICATE NO. 209 ON BUSINESS REPLY CARD ⟶

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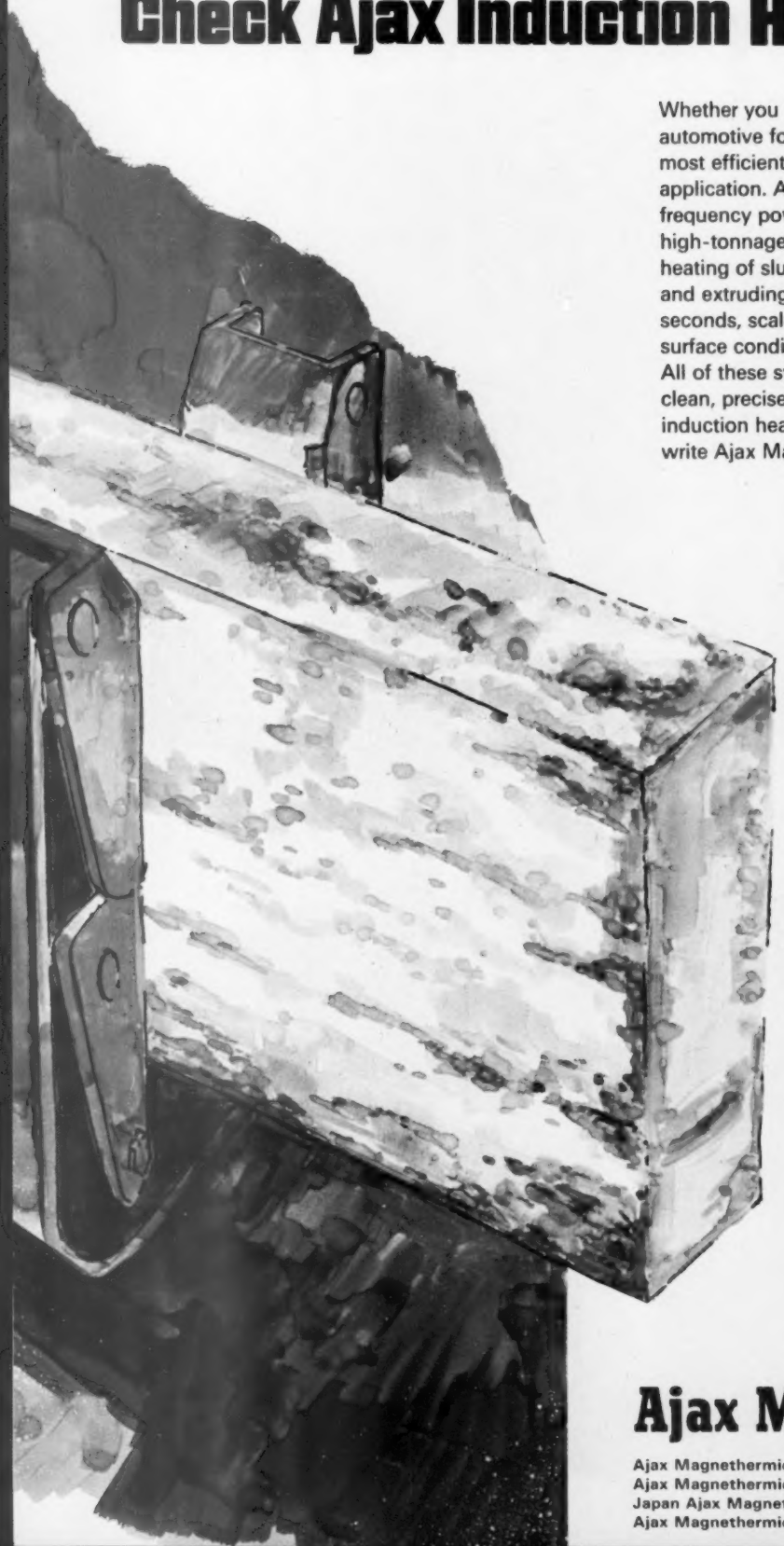
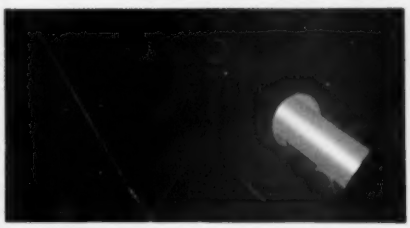


Whether you heat continuous-cast slabs or slugs for automotive forgings, your Ajax representative offers the most efficient induction heating system for your application. A full range of low-frequency and high-frequency power supplies and inductor designs for the high-tonnage heating of slabs for rolling or the continuous heating of slugs, bars, and billets for forging, forming and extruding. Heating time can be cut from hours to seconds, scale losses reduced by as much as 80%, surface condition greatly improved and die life extended. All of these systems are performance-proven for fast, clean, precise heating. And engineered by Ajax . . . first in induction heating technology and service. For information, write Ajax Magnethermic Corporation, Warren, Ohio 44482.

Eaton cut metal loss 70% with this Ajax, 3500 KW, in-line, steel billet heater. Ring gear blank billets are heated at the rate of 18,000 lbs. per hour. Scale loss was reduced from 3.5% to 1.0%.



Bethlehem switched from a fuel-fired steel bar heater to two Ajax, 375 KW, continuous, induction heating systems to eliminate scale problems at its hot nut forming plant. Now surface finish is smoother. Dies last longer.

Ajax Magnethermic

Ajax Magnethermic Corp., Warren, Ohio
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NO. 210 ON BUSINESS REPLY CARD

Planning for—and with—OSHA

"Big Brother" is looking over your shoulder, and "he" goes by the name of OSHA.

People in the Occupational Safety and Health Administration, however, don't think of themselves as outsiders prying into the way you run your operations. They consider themselves partners with you and your employees in *your* fight against on-the-job accidents and work-induced illnesses.

Legally, you're required to provide a facility that is free from all recognized hazards and to see to it that your employees follow what are determined to be safe practices; and, legally, OSHA's people —or state personnel in 20 states with OSHA-approved plans for OSHA compliance—are required to find out how safe a workplace you're operating.

OSHA has been in business for almost three years. About 100,000 of the nation's 4½-5 million workplaces have had an inspection. If a manager or staff man in an industrial organization doesn't have some awareness of OSHA at this point, he must be blind or deaf, or both. But few men in industry feel secure and comfortable with either the personal knowledge they have of OSHA's multitudinous standards or with their operations' complete compliance with the standards.

"In the seminars we conduct in different subject areas, we see many of the same people showing up at two, three, and four of them," says David H. Rhone, assistant regional director, Region III (Philadelphia). "This is indicative that they are trying to get all the information they can."

And, of course, the standards are subject to constant change. Some contained in the Oct. 18, 1972, *Federal Register* (which is the current OSHA "bible"), still are not effective. Revisions also are continuously being made, and new standards added. Useful along with the *Federal Register* is the *General Industry Guide for Applying Safety and Health Standards,* which indexes the standards so their original publication form will be easier to use.

Additional "must" reading for anyone moderately involved with workplace conditions is OSHA's magazine, *Job Safety & Health,* which comprehensively and interestingly covers the gamut of safety/health activities by OSHA, standards-making organizations, and private industry. It lists references to new standards, variances to standards granted to individual companies, and publications by governmental and private agencies relating to on-the-job safety/health. Another basic guide is OSHA's *Compliance Operations Manual,* giving details of workplace inspection procedures, citation and proposed penalty handling, and procedures for contesting any proposed penalties.

Employers must also be completely familiar with the record-keeping requirements of OSHA, and a manual spelling these out in detail with the forms is available from OSHA offices. Also extremely useful is OSHA's Subscription Service, which currently provides five volumes which are updated periodically with loose-leaf inserts to include interpretations of existing standards, modifications, and new standards. This service is available from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402. Its annual subscription price is $9.05.

OSHA is forcing onto industry an awareness to accident/illness prevention that probably would be considered onerous if it dealt with anything except preservation of human life.

It has pushed safety/health into the concerns of top-level executives and into a more prominent place in corporate philosophies. Suddenly, improvement in accident prevention, safety training, and supervisory competence has become a more important part of the measurement of a manager's performance. And it has provided a rallying point for better labor-management relationships.

Any manufacturing man who plans without cognizance of OSHA is guilty today of the grossest kind of negligence. At worst he subjects his firm to the possibility of $10,000 fines and immediate close-downs, and its executives to one-year jail sentences.

"Call on Us." "There's no question that in the early stages of the program—and to some extent right now—business was laboring under some misconceptions and myths about what we're doing and how we do it.

"It was assumed that we somehow would have a very negative impact on industry and commerce. But this is certainly far from the truth when you look at the over-all responsibilities for the safety and health problem. We have to be

continued

concerned with workers' welfare, but we are anxious not to create any serious imbalance in the course of carrying out that obligation."

Assistant Regional Director Rhone (one of 10 to whom the 52 area directors report) thus sets the stage for a look at OSHA's partnership role with businesses and their workforces in their joint fight to improve safety/health conditions.

"When I came into the region about two years ago," he recalls, "the program was still in the problem stage, and I found many employers antagonistic, afraid to talk to us about anything. At that time, we had one man and a secretary to answer inquiries and 'walk-ins.'

"Now, because of the volume of inquiries and walk-ins, we have five people on the staff for their handling; I can't think of any industry that is staying away from us. We're striving for voluntary cooperation with both the employers and the employees, and a major thrust of our efforts is to get the employer to take a knowledgeable look at his operations, particularly those where he may have problems relating to accident or illness.

"This always has been businesses' approach—to identify those areas which are causing problems. If a problem's a drain on production or on capital, the businessman wants to get in there and find out what's causing it and then correct it.

"We're saying that a serious drain on resources is accidents and illnesses, which won't go away unless positive and constructive actions are taken. The businessman must look at them, decide what he thinks must be done, and if he wants to talk to us about them, we're delighted to give him every help we can.

"We will not be consultants, but we will tell a man whether what he's planning to do is in compliance with our regulations.

"Another key part of our activities is meeting with groups. In the past two years, we in this region

David H. Rhone

have talked to representatives of some 50-60,000 establishments. Many of these appearances have been instigated by various groups, trade associations, college seminars, and the like. Additionally, we develop programs for industries that require special emphasis—construction trades is an example.

"These things have helped immensely in changing OSHA's initial negative image; and, by virtue of the top-level involvement at many companies in the safety and health areas, the image many working people have of the corporate structure also is changing—they now see more evidence of interest in their welfare."

Edward E. Estkowski

Assistant Regional Director Edward E. Estkowski (of Region V, centered in Chicago) adds: "We've progressed to the point where we're no longer in the 'announcement' stage. We're at the point where we can be much more specific with potential hazards, and employers can be much more specific—much more direct—in their questions and their concerns about the requirements.

"We're spending more time in the areas of enforcement and in training for voluntary compliance.

"Massive voluntary compliance, of course, assumes that employers know what it is they must comply with. Our training responsibilities are heavy, although recently they've been developing in new directions, including contracting with the National Safety Council for the conduct of seminars, and working closely with the National Institute for Occupational Safety and Health in its educational/training activities."

He further notes that while an employer's knowledge of the standards that are applicable to his business is essential, "compliance does not automatically guarantee a safe workplace." In its over-all administrative responsibilities, OSHA, he says, "is turning more toward safety performance evaluation than to specification performance." He notes that much more is being said by employers and their worker representatives about both the adequacies and the inadequacies of the available standards.

Currently, he also observes, there are many external factors that may have an adverse effect on OSHA's and industry's safety/health work and accomplishments. Questions now being raised, he says, are whether the energy crisis with its effects on environmental protection practices and requirements and possible changes in length of workdays will cause some curtailment of concern with pollution while also creating new frustrations and possibly greater on-the-job fatigue that will cause more accidents.

Where the Problems Lie. It might be assumed that the growing sophistication by employers and by OSHA's people after more than two and a half years of living under the safety/health requirements would be reflected in greater complexity of the problem areas. Presumably, the rising attention to and concern with health problems, as apart from safety conditions, is an indication in that direction. However, the most frequently asked questions to OSHA offices and the most common violations found by the compliance officers do not support this assumption.

OSHA calls them "the dirty half-dozen"—violations involving machine guarding, walking and working surfaces, the National Electric Code, materials handling and storage, hazardous materials, and fire protection. They constitute more than 70 percent of the violations that are cited, and one of them—machine guarding—accounts for almost 40 percent of the violations. These, of course, are areas that are reasonably universal; they, however, are also easily recognizable as potential hazards. In the durable goods manufacturing industries, violations with welding, cutting, and brazing take the place of dishonor away from hazardous material and fire protection to give these industries their own "dirty five" to concentrate on.

The machine guarding violations, significantly, are led by improperly shielded fans—certainly not a "sophisticated" or complex problem beyond the competence of any except a skilled safety professional to spot and fix.

If sophistication in hazard detection and elimination has not yet developed in the run-of-the-mill businesses which OSHA has inspected, it certainly is growing in OSHA's own ability to focus its efforts where the major problems lie.

OSHA's Washington-based Office of Management Data Systems feeds the information from some 25,000 documents each month into its IBM 360-65 computer. Out come patterns showing primary hazard conditions by industry, establishment size, OSHA region, individual compliance officer, or other desirable breakdown. More effective assignment of OSHA compliance officers and development of special emphasis programs also are key benefits of the system.

Its almost three years' experience has not caused OSHA to change its "target" industries where the highest injury-frequency rates exist. Longshoring, lumber and wood products, roofing and sheet metal, meat and meat products, mobile homes and other transportation equipment remain on its high-priority list.

Initially, it was expected that the high-accident "target" industries would be changed periodically; people in OSHA now feel that particular kinds of hazards—rather than particular industries—warrant special attention, and, within the construction industry, for example, trenching and shoring operations are coming in for heavy special safety training emphasis.

A "target" health hazards list also has been developed to focus particular attention on five of the most commonly used toxic materials of some 15,000 that have been identified. Asbestos, carbon monoxide, cotton dust, lead, and silica are the five current "target" substances.

OSHA's Training Role. Occupational health is a broad field where OSHA and industry are still learning many of the ropes. Emphasis in hiring at OSHA offices also is heaviest for industrial hygienists at this point.

Says Assistant Regional Director Rhone: "Initially, most of our compliance officers came out of industrial safety work; they were familiar with it and had had only limited experience in the health area.

"In the future, I see less separation between the two disciplines—safety and health. We have a system whereby most of the preliminary plans for health hazard prevention that are submitted to us are reviewed by the safety men. As we add industrial hygienists to our staff, a lot of these people will be used to train our safety officers in what to look for, how to use the instruments and monitoring devices. Our ability to answer questions about the health side of our dual area of responsibility also will be improved."

Training of its own people and people from the private sector is a vital part of OSHA's over-all responsibility; and, initially, its absence was an area where many in industry leveled their criticism. Education and training for safety and health, they contended, should have preceded OSHA's inspection activities.

OSHA now could counter by saying: Put up or shut up!

Its training activities and the stimulation it is giving to others' training activities are taking a wide variety of forms.

Colleges and consultants immediately realized the long-range significance of OSHA and responded with countless courses and seminars. Associate degree programs in community colleges now are numerous. OSHA itself operates a Training Institute near Chicago. While its primary purpose is to train compliance officers and other federal and state safety/health workers, it also accepts personnel from private, industrial organizations. Its course materials are available for copying or short-term loan at all regional OSHA offices. (For information on courses, write: Registrar, OSHA Training Institute, 10600 West Higgins Rd., Rosemont, Ill. 60018.) An OSHA contract with the National Safety Council gives the responsibility for conduct of seminars to that group.

A directory currently is being compiled by OSHA on job safety and health courses being offered by private organizations and educational institutions.

Bendix Corp. has an OSHA contract to develop and test a set of guidelines aimed at enabling employers to come into compliance

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Is Your Safety Program Safe?

To find out, rate your plant against this checklist developed by C. L. Carter, Jr., and Associates, Inc., Richardson, Tex. Dr. Carter suggests your rating be qualitative. Rate yourself: E—Excellent; G—Good, above standards; A—Adequate, meets standards; P—Poor, below standards; U—Unsatisfactory

CONTROL OF ACCIDENT HAZARDS
(plant and equipment)
___ Plant or department layout—aisles, machines, storage, etc.
___ Special and periodic safety inspections and seasonal or infrequent operations
___ Housekeeping—materials storage, etc.
___ Safeguarding of presses, mechanical equipment, machines
___ Portable electrical equipment
___ Hand tools
___ Material handling equipment provided with overhead guard
___ Electrical
___ Floors
___ Stairs and steps
___ Lighting—adequate (safety clips fluorescent tubes)
___ Noise
___ Ventilation
___ Proper barricading

TRAINING PROGRAMS AND SAFE WORK PRACTICE
___ Line supervision basic safety fundamentals
___ Indoctrination of new or transferred employees
___ Safety sampling
___ Job safety analysis
___ Safe work practices—written, oral

SAFETY RECORD
(improvement compared to previous appraisal)
___ First aid cases
___ Doctor's cases
___ Disabling injuries
___ Frequency rate
___ Severity rate
___ Property damage over $100

MOTIVATION AND COMMUNICATIONS
___ Bulletin board use for safety items —safety displays and demonstrations
___ Use of visual aids, safety films
___ Special local safety messages, newsletters, etc.
___ Plant safety contests
___ Off-the-job safety activities and promotions
___ Safety suggestion program

ORGANIZATION AND ADMINISTRATION
___ Safety policy committee
___ a. Attendance at meetings
___ b. Completion of recommendations
___ Safety standards and reference material
___ Line and staff communications and contacts
___ Special safety task force committees

PERSONAL PROTECTIVE EQUIPMENT
___ Safety glasses, plano, prescription
___ Safety shoes and/or metatarsal protection
___ Safety goggles
___ Safety helmets
___ Face shields
___ Safety caps
___ Flame-retardant aprons
___ Ear protectors
___ Safety belts, harnesses
___ Rings, gloves, loose clothing not permitted around moving machinery

EMERGENCY CONTROLS
(riot, disaster, etc.)
___ Emergency plan—riot control
___ Disaster plan—other

CONTROL OF LIABILITY EXPOSURE
___ Hazards to the neighborhood (including waste disposal, smoke, etc.)
___ Products liability

ACCIDENT AND INJURY REPORTING
(medical-treatment injury)
___ Reporting use of first aid pass
___ Disabling injury reporting—foremen's accident investigation report
___ Injury investigated by safety staff
___ Injury investigated by line personnel
___ Injury reported to corporate safety officer
___ Periodic and special studies

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with the safety/health training requirements in OSHA standards. This will be available by mid-year.

OSHA itself is well on the way to becoming an important training ground for some of industry's future safety/health professionals, reversing the past trend in which OSHA heavily recruited from industry. Currently, however, OSHA is making a strong recruiting appeal to hourly workers with safety committee or apprenticeship training experience.

Government being what it is, OSHA, which is part of the U.S. Department of Labor, isn't the only governmental center of training in occupational safety and health and for information dissemination, however.

The National Institute for Occupational Safety and Health, based in Cincinnati, O., and under the U.S. Department of Health, Education, and Welfare, is conducting 17 short courses in 10 subjects related to safety/health during the remainder of this year. (Write: Div. of Training, NIOSH, 1014 Broadway, Cincinnati, O. 45202.) NIOSH also is developing a directory of training materials and courses for mid-year publication.

Less Federal, More State. A basic philosophy in the federal act that created OSHA was that, in time, most of the responsibility for businesses' accident/health compliance could be returned to the states.

At the outset, it was considered necessary that universal safety and health standards be set up and enforced at the federal level because individual states had been lax with regard to worker safety/health in the past, and the level of enforcement was extremely uneven.

A provision in the OSHA's enabling legislation permits the federal government to pay 50 percent of a state's cost of manning and enforcing the OSHA mandates. Twenty states now have formulated OSHA-approved plans for obtaining business safety/health compliance. OSHA will, however, monitor the states' performances against the federal requirements and objectives. OSHA officials emphasize that the movement of enforcement activities back into states' jurisdictions should be beneficial and should encourage more innovative development of better safety/health practices. "State people," one OSHA man says, "should be able to look at the variations of the industries and the technologies their states

continued on page 41

INDICATE NO. 211 ON BUSINESS REPLY CARD ⟶

EAGLE

CAN HELP!

Use These Eagle Products to Comply with OSHA

FAUCET SAFETY CANS
1327
1328
1417

TYPE 1 SAFETY CANS

1313	UI-2S	UI-10FS
1314	UI-4S	UI-25FS
1315	UI-10S	UI-50FS
1316	UI-25S	
	UI-50S	

SAFETY PLUNGER CANS
P-701
P-702
P-704

SAFETY BENCH CANS

B-601	B-606
B-602	B-608
B-604	

LAB CANS
1300
1301
1400
1401

DRIP CAN
DP-802

DISPOSAL CANS
1323 1423
1325 1425

TYPE 2 SAFETY CANS
U2-26S
U2-51S

OILY WASTE CANS

906	921	914FL
910	906FL	921FL
914	910FL	

SAFETY STORAGE CABINETS
1930 1945 1932 1947

OSHA imposes a responsibility upon employers and employees to provide a hazard-free environment **or adequate protective equipment.** Everyone in every industry is affected by OSHA.

OSHA requires you to use safety cans, oily waste cans and safety storage cabinets. Eagle approved Cans and Cabinets meet OSHA requirements. Use them where flammable or combustible liquids are stored or handled.

Order from your local industrial, safety, or contractor supplier. Write for Eagle Catalog on the Complete Line.

EAGLE **MANUFACTURING COMPANY • WELLSBURG, WEST VIRGINIA 26070**

Oilers, Oil & Gasoline Containers, Safety Cans & Cabinets, Oily Waste Cans, Faucet, Lab & Disposal Cans

OSHA

Airflex
Press Controls

Answer
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Airflex
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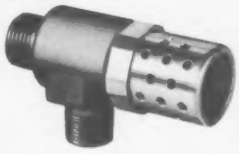
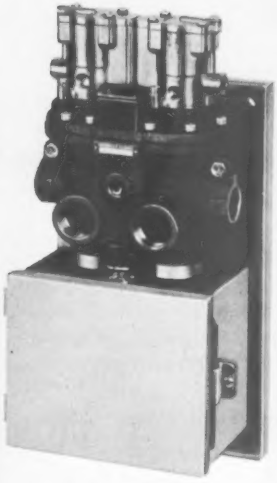
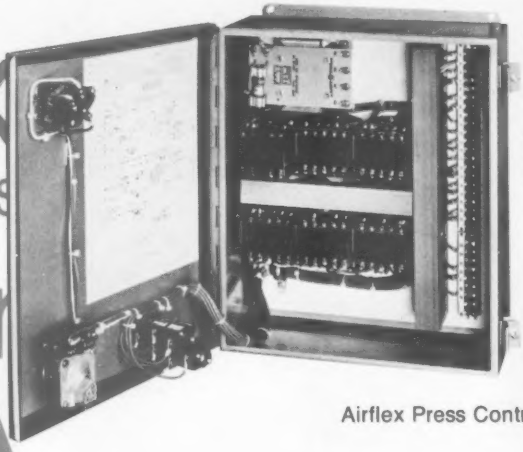
OSHA

Airflex Quick Release Valve & Muffler





Airflex Dual Valve



Airflex Press Controls

We can help you meet OSHA standards with these Airflex press control products.

We know what it takes to comply with ANSI B11.1-1971. And we'd be glad to survey your presses, give you the benefit of our thinking to help you meet your obligations under OSHA.

We have the know-how and the products to help you update and convert your presses to meet the new OSHA standards. And while we're at it we'll show you how to bring your presses up to new standards of operation with Airflex® self-contained clutch/brake packages. For complete information, write Eaton Corporation, Industrial Drives Division, 9919 Clinton Road, Cleveland, Ohio 44111.

EATON
Power Transmission Systems

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contain and develop constructive approaches to their problem areas. We see the opportunity for some new constructive relationships developing—it brings the problem-solving people and the solution-seeking people closer together."

"Good Faith" Is a Two-Way Street. An employer thinking that OSHA's stringent requirements will be "watered down" as state enforcement increases is engaging in wishful thinking. OSHA must be convinced that the individual state's surveillance of accident/health conditions is equal or superior to that under federal supervision, or the state's plan will be terminated. Duplication of effort is not intended, but a general increase in the total amount of manpower and financial resources devoted to safety/health enforcement and improvement is a goal in the federal/state programs.

OSHA people carefully avoid indicating that their manpower will be reduced as state enforcement activities increase. They are conscious that there are many vocal groups contending currently that OSHA is not staffed for the massive inspection/enforcement efforts which past accident/health conditions demanded. To answer these critics' charges, its emphasis is increasingly on numbers of inspections performed.

But OSHA also recognizes and is responsive to its critics in industry's ranks who have complained over the nature and contents of many of the standards to which companies must conform.

From a practical standpoint, OSHA men privately tell the PLANBOOK's editors, the consensus standards leave much to be desired both in their contents and their omissions. In many cases, these standards were developed as *design* standards and were not intended for the use to which they currently are being put. They contain unnecessary detail in some cases and ambiguous wording in others. To OSHA's credit, many of these now have been weeded out and some that are being heavily contested by industry experts are "in limbo" with compliance officers told by their superiors to "go easy" on violations or proposed penalties involving such standards.

Another valid point that OSHA unofficially recognizes is that some of the standards were designed for *property* protection, not worker protection except in very indirect ways. Such standards, therefore, go beyond OSHA's statutory area of concern, and its people will be reluctant to contest them because of their shaky legal ground.

Inspected employers who feel the citations and proposed penalties they've received are improper are urged by OSHA administrators to discuss these informally with the area's director or staff personnel before an official "contest" must be filed or the proposed penalty accepted.

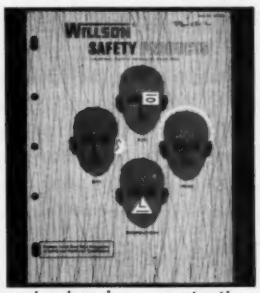
"Safety and health are too important subjects for us in OSHA and employers in industry and business to be in 'adversary' roles where it can be avoided," says an OSHA man. "And we must rely primarily on voluntary compliance. There's no need or desire on our part to expand OSHA to the point where a government inspector will be peering over the shoulder of each business establishment or individual worker. We ask for good faith on the part of employers. We, too, must show our good faith toward employers and their employees within the statutory requirements upon us. We're trying very hard now to operate under that philosophy." ■

useful literature

Barksdale pressure switches to shut off power equipment in the event of a pressure failure, in accordance

with OSHA requirements, are described in a 4-page brochure. (Delaval)
Indicate No. 568 on card

A 4-page safety equipment catalog shows equipment for eye, head, respiratory,



and hearing protection. (Wilson Products Division)
Indicate No. 569 on card

Opportunities for increased recycling of metal solid waste is discussed in a 6-page reprint of a paper delivered at the third Mineral Waste Symposium. (Battelle Memorial Institute)
Indicate No. 571 on card

Design principles for low-noise portable pneumatic

equipment is discussed in an ASME paper. (Chicago Pneumatic)
Indicate No. 570 on card

A series of brochures relating to dust collection are available from Carborundum, as follows: **Posi-Pulse**

dust control systems. Sixteen pages. *Indicate No. 574 on card.* **Electric Arc Furnace** Dust and Fume Control. Sixteen pages. *Indicate No. 575 on card.* **Structural Baghouse** Dust Control

continued

useful literature

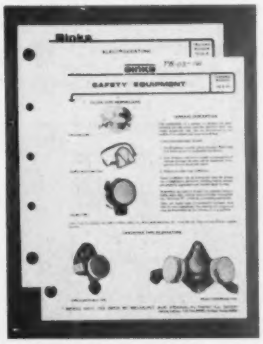
continued

Systems. Twelve pages. *Indicate No. 576 on card.* **Totalaire Atmospheric** Air Filter. Eight pages. *Indicate No. 577 on card.* **Carborundum-Pangborn** Type CT-2 Intermittent Collector. Ten pages. *Indicate No. 578 on card.* **Pangborn-Type** "CV" Ventrijet Wet Dust Control. Eight pages. *Indicate No. 579 on card.* **CN-2 Unit Type Dust** Collector. Six pages. *Indicate No. 580 on card*

How to detect leaks with chemistry is the subject of a 2-page brochure. It dis-

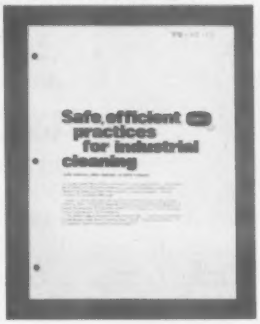
cusses several testing procedures. (American Gas & Chemicals, Inc.)
Indicate No. 581 on card

A pair of 4-page brochures deals with safety equipment for spray finishing systems,



and a typical electrocoating system. (Binks Mfg. Co.)
Indicate No. 583 on card

Safe, efficient practices for industrial cleaning are de-



scribed in a 12-page brochure. (Oakite Products, Inc.)
Indicate No. 584 on card

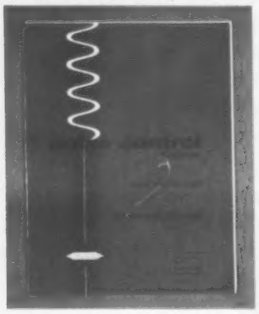
A packet of technically oriented material on noise contains brochures and data sheets on how it can affect operation, legislation against it, and what can be done about it. (Polymer Corp.)
Indicate No. 585 on card

Type CU dust collectors described in a series of data sheets defining different models that are compact, lightweight, and portable. (Carborundum Co.)
Indicate No. 573 on card

Rolling bolster feed units that are said to meet OSHA safety requirements for sec-

ondary press operations are described in an 8-page brochure. (Thompson Industries, Inc.)
Indicate No. 586 on card

An 18-page noise control directory lists air exhaust mufflers for cylinders, motors, valves, tools, vacuum



pumps, and air-operated devices. (Allied Witan Co.)
Indicate No. 587 on card

Instruments for checking environmental safety conditions are listed along with

detailed instructions about their use in an 8-page full-color catalog. (Edmont Wilson)
Indicate No. 588 on card

What is noise, its sources, how it is measured along with some excellent suggestions for correction are included in a 20-page Machine Tool Noise Data booklet. (Bullard Co.)
Indicate No. 589 on card

Hydroclones and their use in recirculating systems are described in a paper originally presented at a regional symposium of the American Institute of Chemical Engineers. (Donaldson Co., Inc.)
Indicate No. 572 on card

A survey guide, in checklist form, designed to help conveyor users determine whether they are in OSHA-compliance is offered by Acco. The 8-page guide

covers major points of conveyor systems and the OSHA standards that apply. (American Chain & Cable Co., Inc.)
Indicate No. 590 on card

Safety guidelines from OSHA standards on walking/working surfaces, guarding holes and openings, stairs, ladders, and machine guards are provided in 32-p. booklet. (Joseph T. Ryerson & Son, Inc.)
Indicate No. 591 on card

A press safety kit includes a selection of eight practical brochures related to OSHA and the metal stampers' needs. (Babcock & Wilcox)
Indicate No. 582 on card

FORMING due for improvement

The art of forming materials into engineered shapes is one of the most widely diversified and active production processes. Although metal stamping is the most widely recognized forming process, sand casting, forging, die casting, powder metallurgy, plastic molding, etc., typify the wide array of forming operations. Depending on the particular process utilized, parts are formed from the entire gamut of materials ranging from aluminum to zinc.

State-of-the-Art. Technological advancements in forming processes have progressed at a phenomenal pace during recent years and predictions are that the pace of technological developments will progress at an even faster rate in the future. Improvements thus far achieved are being used as stepping stones for future developments. Machine builders and users alike are busily trying to pyramid accomplishments into more highly sophisticated equipment and future processes.

Reviewing the problems and some of the solutions that are being devised with the aid of equipment builders highlights three main areas of forming—metal stamping, plastic molding, and die casting.

METAL STAMPING

Metal stampers claim their most serious problem is the lack of availability and long delivery time for presses. New presses are needed to effect capacity increases, and a significant number of the older presses are in need of replacement.

Late press delivery caused a major problem at A. O. Smith Corp.'s Automotive Division in Milwaukee, Wis. The plant, which produces frames for the automotive industry, has instituted a $6.5 million capacity increase program involving 31 new presses. Walter Sauthoff, manager, plant equipment engineering, described its problem: "I don't know any way to work around press deliveries which are six weeks late.

"Our capacity increase program involved 31 new presses ranging to 800-ton. That is a heap of presses, and the installation procedure is a king-size task requiring careful planning and execution. Obviously, production must be disrupted, but it must be held to an absolute minimum.

"When the orders were placed, the press builders furnished us a delivery schedule which we considered a firm commitment. Our installation program was carefully timed and put into effect to provide a highly productive and smooth transition. Foundations were dug, pits constructed, etc., in preparation for the new presses.

"However, about two weeks prior to the scheduled delivery, the press builders phoned to explain they had encountered a problem, and our presses would be up to six weeks late. If this problem had happened to only one press, or by only one builder, it would not have been too bad, but half of our presses were delayed.

Royal Bodine
Bodine Electric Company

Somehow, someway, our production workers managed to produce automobile frames at the rate of several million per year, but believe me it was a problem."

Foreign Orders Blamed. Royal Bodine, executive vice president-engineering, Bodine Electric Co., sees manufacturers forced into a "go-no-go" situation. "I am vitally concerned that American industry is slipping behind the rest of the world. Our machine tool industry kept busy selling

their products to foreign manufacturers overseas during the previous business lull. Now when U.S. industry needs new equipment, it is not available; builders are quoting a 50-odd week delivery.

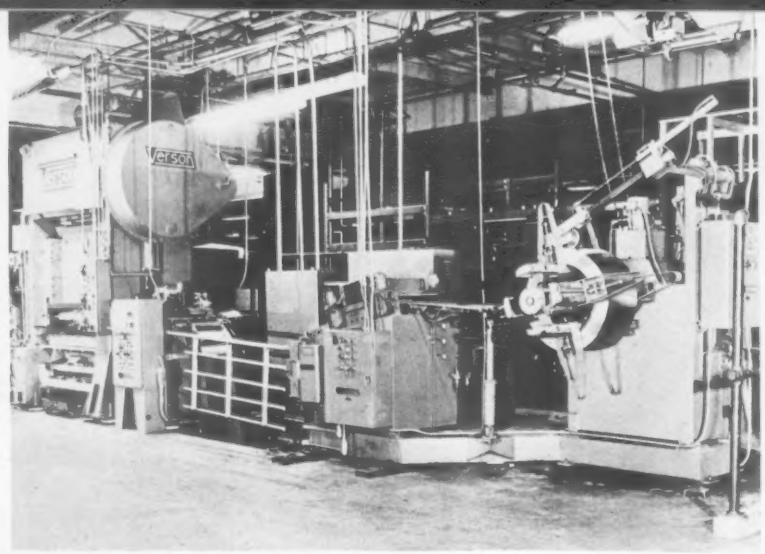
"If I order a new press on those terms, with its delivery about one year in the future, the product may be obsolete before the machine is delivered. It is a big problem. The question is—do you or don't you order a press."

Help from Overseas. Some manufacturers are considering foreign presses as the immediate solution to the delivery problem. "I'd buy a foreign-built press today if delivery was fast and it had the bed area and the tonnage requirements we need," says Patrick Brogan, plant superintendent at Imperial Eastman Corp., subsidiary of ITE. "We have all domestic-built presses in operation, but the U.S. builders' deliveries out over a year pose a serious problem that tempts foreign consideration.

"We intend to remain in business through the energy crisis and are beginning to realize that the press name is only a name. If a press will do the job, we'll tool it up and put it to work."

Foreign-built presses are contributing significantly to both productivity and quality improvements at Teletype Corp., and C. D. Seidler, manager of new products planning, says: "We are constantly improving stamping operations and evaluating special types of presses. Our objective is to increase productivity and quality and minimize the tedious operator dependency associated with press operations.

Patrick Brogan
Imperial Eastman Corporation



A punched card press control system at the Art Steel Co. contributes to a 100 percent productivity increase and a vast flexibility improvement. Changeover time is also minimized. The card reader controls several press sequences including spm, the stock feed length and feed rate, along with straightener speed and total number of parts

"Our operations are utilizing some Swiss-made Osterwald fine blanking presses that are providing worthwhile productivity and quality gains. They operate slower than some other makes, but they produce a fine surface finish compared to a rough shear line from conventional presses. In fact, the high quality surface finish produced by the Osterwald presses has contributed to the elimination of grinding operations on certain parts which effected a significant cost reduction."

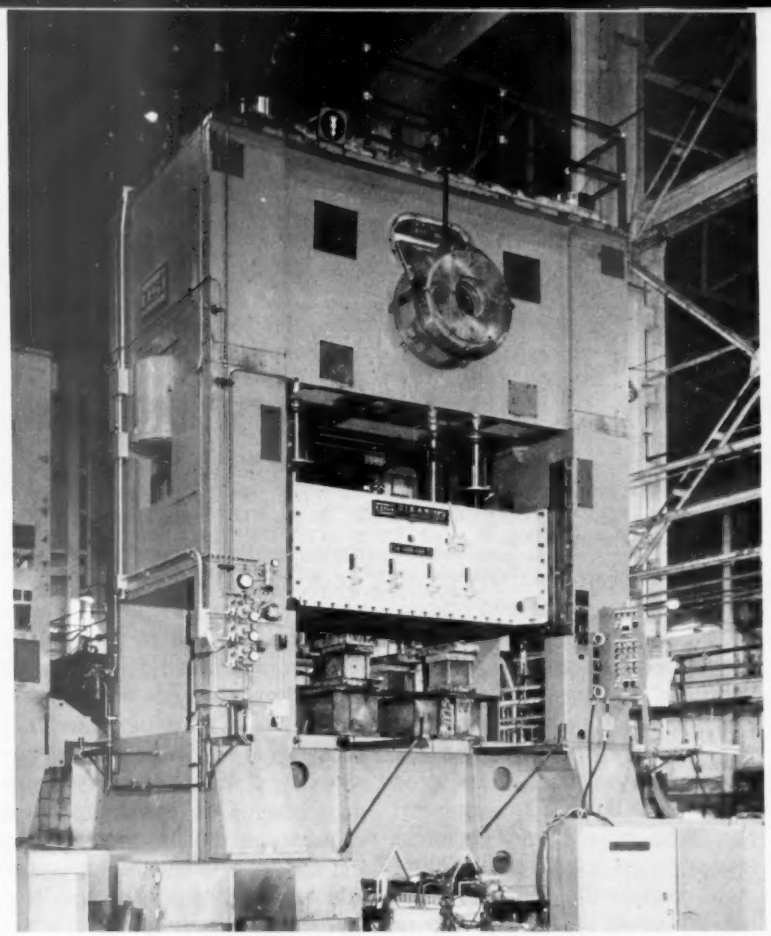
Disenchantment with foreign-built presses, however, is expressed by James McCarthy, manager of manufacturing, Thor Power Tool Co. "I don't want more foreign-built presses. We have a few in our Canadian operation, and in some respects their quality is excellent. However, the metric system creates a serious problem. When a foreign press does break down, it is necessary to first make a drawing converting the metric measurements into decimal dimensions for our toolmakers. This procedure consumes valuable time during which the press is inoperative—it's an unwarranted production loss.

"Another important point is that the rated tonnage of a foreign-built press is normally the machine's maximum capability; you had better not exceed that rating. The safety factor that our domestic builders build into a press is lacking in foreign machines."

What the Builders Are Doing. No one is more concerned with the problems than the press builders. The builders are facing many of the same problems as their customers. Widespread material shortages ranging from raw materials, bearings, castings, etc., are holding up the construction of presses. Government-imposed safety and noise regulations present the identical problem for both the user and builder.

Nevertheless, the press builders have a commitment to industry, and each builder is deeply concerned with and endeavoring to improve its deliveries. For example, Minster Machine Co., last year completed a new modern over-77,000-sq-ft captive foundry operation. Minster's president, Harold J. Winch, says: "The new Casting Facility provides a 30 percent capacity increase over our previous foundry operation. It represents a careful plan which began about three years ago when we analyzed the casting situation."

Their problem in obtaining ma-



Typifying today's progressive contract stamping operations, Davis Tool and Engineering Co. last year installed their sixth new press in as many years. The latest $1 million 1000-ton 72-in. by 120-in. four-point blanking press complete with a new coil handling line produces parts for the auto industry

terials is related by Minster's executive vice president, Norman L. Dunlap: "Steel plate is the most difficult material to obtain. But an entire list of scarce commodities is developing. Friction material for clutch and brakes is in short supply since Johns-Manville closed one of its asbestos processing plants. There are also shortages of vinyl covered wire, galvanized pipe, fiberglass press guard material, ferro silicon pig for melting operations and unbreakable scrap."

USI-Clearing, a U.S. Industries' company, is taking a different approach to the press delivery problem. "First, we are increasing press building productivity to the maximum," reported John Powers, director of domestic sales. "Second, we have completed arrangements to become the sole U.S. sales and service facility for Essa and Platarg presses. Third, we are expanding the service end or press rebuilding area. The objective is to aid our customers who are in dire need and can't wait for the delivery of new presses."

Verson Allsteel Press Co. is fully aware of the delivery problem and is helping customers by making some stampings for them. "I don't have a viable answer to the press delivery problem, although we are doing everything possible to help our customers," says Walter C. Johnson, vice president, industrial products marketing. "Verson recently instituted an extra service. We'll produce production stampings for a customer when the press delivery is beyond the normal time period. Chrysler Corp. used this service last fall. We produced several thousand stamped parts for the front bumper energy absorbing system while their new press was being built.

"Press buyers can help themselves, to some extent, with the delivery problem, by taking a second or maybe a third look at their planning; there may be an opportunity to conserve presses. An appliance manufacturer recently purchased two large transfer presses which replaced an entire press room of older machines. A total of 14 different dies are being used in the pair of new presses to produce his product. This type of planning can relieve a press capacity problem and reduce delivery problems. We are evaluating an expansion program, but it looks a long way off," he adds.

Niagara Machine & Tool Works' H. Stanton Cheyney, general sales manager, makes another suggestion as a possible way of speeding press deliveries. "A press buyer can save both time and money by taking steps to compromise on the machine specifications," he claims. "Engineering is one of the primary factors contributing to the long deliveries. If customers could modify their specifications to use a standard press, or even a special type which has been built, a large portion of the engineering time could be saved. More expedient delivery can result."

Technological Developments. Large-scale advancements have been made in the stamping industry during recent years. These include higher tonnages, larger bed areas, sliding bolsters, improved control reliability, faster and longer-life clutch and brake, variable torque, monitoring devices, quick change die provisions, and numerous others. And, numerous additional gains are being developed or are in the planning stages.

Looking into the near future, Verson's Walter C. Johnson says: "We anticipate control improvements will contribute to increased press speeds. Feedback features, coupled with mini-computers, offer the potential for presses to detect and correct their own problems. Additionally, a hydraulically actuated clutch and brake in conjunction with a hydraulic overload mechanism could be engineered to stop a press stroke at a preset

distance from the bottom to avoid smash-ups."

At USI-Clearing, John Powers also predicts a significant improvement in press controls: "We are working with an automobile company to develop a computer-controlled blanking press system. The development is in the final stages and will effect a king-size saving of coil steel. The system will incorporate a digital feedback loop to provide optimum blank length and a corresponding maximum press operating speed."

E. W. Bliss Co.'s George Crook, vice president, customer services, says: "We are developing a new press brake which is presently being production-tested. It offers several pertinent improvements over existing models. Also, a newly designed center post guide air cushion which will accept off-center loads is in the final development stage."

Progress in OSHA Conformance. OSHA's safety regulations present one of the most difficult and costly problems ever encountered by the stamping industry. The regulations necessitate numerous modifications in a variety of areas affecting operator safety and noise control. However, in a large number of these areas solutions to the problems are not readily available. And, a cost estimate for the stamping industry's total compliance to the regulations has been placed at tens of millions of dollars.

The OSHA regulations define stamping press safety into two areas of responsibility. Press users are responsible for point of operation safety features; these include protection for the operator from all pinch points associated with the dies and/or tooling. Press builders are charged with the responsibility of developing and incorporating several safety features relative to the basic machine.

Users generally agree with the moral objectives of the OSHA regulations but are far from enthusiastic over the large expenditures required. In endeavoring to comply

J. W. Rose
Bliss & Laughlin Industries

with the government mandates, some are succeeding and making productivity gains at the same time, but others are still trying to lick their problems.

A manufacturing engineer at a medium-size company, who asked to remain anonymous, cited some progress: "I installed mechanical part feeders, magazine loaders, chutes, rotary tables, etc., to eliminate hands-in-the-die press feeding. We could do these things to comply with the OSHA mandates —normally management would insist that we discover better returns on our investment. However, in conforming to the regulations, we also made some worthwhile productivity improvements."

Commenting on the no-hands-in-the-die OSHA mandate, J. W. Rose, vice president, metal products group, Bliss & Laughlin Industries, believes that a middle ground agreement is needed. He says: "We have practiced no-hands-in-the-die press room operations for years. No manager worth his salt will allow an unsafe working condition in his plant. But, when we must remove a press operator from the die area before he can push a button, this restricts the operation. Sure, small-size high-production parts can be fed mechanically, but large-size low-to-medium volume parts present an entirely different ball game. There must be a sensible trade-off between industry and the government mandates. Safety, of course, is mandatory, but we need a clear definition and a better understanding of employee safety."

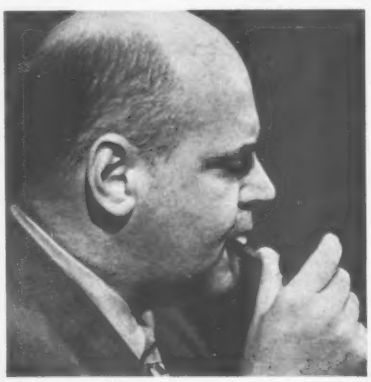
"The solution in limiting noise from stamping operation is not easy nor readily available," says Larry Levine, manager of manufacturing engineering, Hotpoint Co., division of General Electric Co. "A large several hundred ton press blanking stainless steel is a noisy operation. Moreover, it is nearly impossible to quiet it down —in fact, we don't know how.

"Enclosures are not the ultimate solution to reducing press room noise, particularly in an average crowded shop. Enclosures consume too much floor space and seriously restrict die changing and maintenance functions.

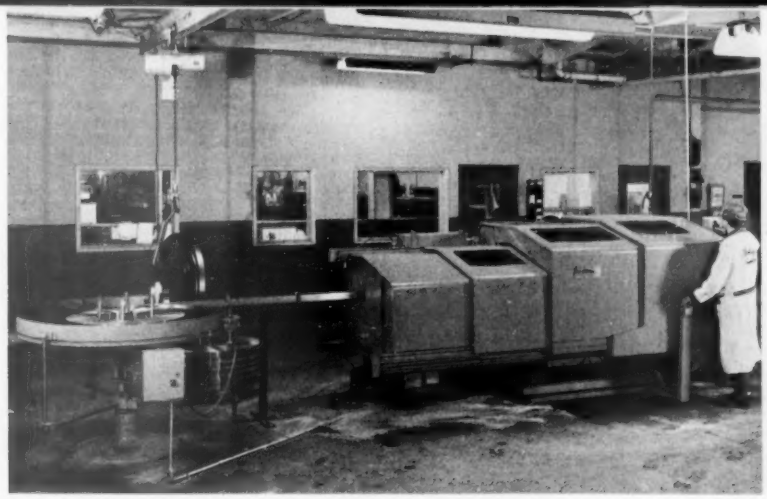
"We have tried but had little success in quieting down our stamping operations from one level to another. The mandated noise controls are difficult to meet. We will continue to try and I am confident we will succeed, but it is an uphill battle all the way."

A manufacturer of large construction equipment is attacking the noise problem differently. "We recently implemented a program to concentrate on one press a month," reports Robert H. Yanker, Aurora plant manager, Barber-Greene Co. "Although too new to provide exact results, the program's objective is to expend maximum effort on each press and lick one problem at a time."

"Industry is getting a fast education from the government-imposed regulations," exclaims Wal-



Robert H. Yanker
Barber-Greene Company



SAFETY IS NO CHANCE FOR AN ACCIDENT, as provided by a novel telescoping guard system on a U.S. Baird Multi-Slide machine at the Dexter Lock Co. Sliding guards completely enclose the machine during its operation and yet afford unlimited accessibility for the routine setup and maintenance procedures

ter Sauthoff, manager, plant equipment engineering, A. O. Smith Corp.

"We are developing expertise in areas that we never knew existed 10 years ago. I have two engineers employed full time making sound level tests throughout our manufacturing operations.

"A great deal has been learned about noise control, but in my opinion, we still know too little. Lead partitions, spray on foam, etc., are solving some problems. We are developing a group of experts in this area and we'll be a lot smarter after a few years' experience."

Niagara's H. Stanton Cheyney explains their approach: "We are investing a considerable amount of time and dollars in the development of reducing and controlling press noise. The prime source of noise from a stamping operation is a punch striking the work. This noise can be reduced by analyzing the load versus time characteristics of a stamping operation and making die corrections. This type of noise analysis can be made with time-base recording instruments such as an oscilloscope. Using a slower or more reasonable press speed minimizes vibrations and contributes to a significant noise reduction. When the slower press speed limits productivity, multiple part producing dies can be used to provide the required production volume. One press user I know changed to a slower press speed in combination with a multiple-part die and reduced the operation's noise level by a full 10 dBA without impairing the press output.

"Reasonable press speeds usually provide unforeseen, but worthwhile benefits in reduced maintenance and longer die life. Therefore, we are attempting to develop more automated equipment, compatible with the future highly sophisticated tooling and capable of operating within the prescribed noise level," he adds.

Walter C. Johnson of Verson says: "We are working on the stamping operation noise problem, but have not discovered a common solution. Good quality vibration dampeners minimize the noise transmission. Our engineers are also evaluating spring-loaded hydraulic die cushions to afford a significant noise reduction through the elimination of air exhaust."

Bliss's Crook related his company's over-all approach to the OSHA regulations: "We are making every effort to assist press users in conforming to the government regulations; some worthwhile gains have been made. For example, cast iron herringbone gears provide a significant noise reduction, although they cost about 15 percent more than previous gears. We will also supply cast iron gears to help press users reduce their noise regardless of their make or age of press.

"Bliss also provides three types of packages to help users update existing presses to conform to the press safety standards. A complete retrofit service is available at two Bliss plants. A customer's press which is scheduled for a control retrofit is rated 'top priority,' and actually scheduled ahead of any other work in our plant. Package control systems are also available to customers who prefer the retrofit be completed in their plant."

John R. Danly, vice president press sales, and director of engineering at Danly Machine Corp. reports: "We are seriously attempting to reduce the press noise through improved components. We are working with such suppliers as electric motor manufacturers in an effort to reduce the noise level."

Minster's president, Harold J. Winch, explains his company's efforts in the area of noise reduction: "Minster is investigating every method of noise reduction. Built-in sound enclosures offer a potential solution in some cases. Remote operator controls provide another form of a solution."

While press users and builders may debate the feasibility of press enclosures, a German builder has one in operation, and it has reduced the noise level for a specific operation by a whopping 20 dBA.

Last summer, L. Schuler GMBH, the parent company of Schuler Presses America, Inc., exhibited a completely enclosed blanking press producing stator laminations for electric motors. Operating at 350 spm, the 350-ton press blanked laminations within the mandated 90 dBA sound level. Without the enclosure, the same press produced a sound level of about 110 dBA. The steel enclosure with sliding doors and observation windows has a slit through which the coil steel feeds. Blanked laminations discharged through a similar slit via magnetic belts.

Need for Better Builder-User Relationship. Users are expressing

a need for and desire in improving their relationship with press builders. "I would appreciate the press builders becoming more seriously involved with my problems," voiced Charles Eberhardt, manufacturing manager at Caterpillar Tractor's Aurora plant. "We would prefer the press builder review our requirements and advise us the quantity and quality of parts his equipment is capable of producing.

"Our primary interest is continual production, not a specified number of parts during a short trial period. Therefore, we are interested in a builder's commitment that the equipment we purchase will perform the operation for which it was intended. We don't want to purchase just plain machines—we want a commitment."

L. Paul Williams, manufacturing manager, Controls Division, Eaton Corp., discussed his feeling about 'turnkey' systems: "I would prefer to purchase turnkey systems. However, in my experience, most of our suppliers neither have the inclination, the desire, nor the talent to provide a complete productive system.

"A few years ago, we experienced a problem. The operation involved encapsulating an electrical coil, and a shuttle press complete with a mold was urgently needed. The time schedule did not permit an in-house development. We searched far and wide for a source to provide us the system, but no takers were located.

"Finally, we contacted New Britain Machine Co., who became interested in helping us. They were the single company which indicated a willingness and the capability to assume the system's responsibility. We bought their press and mold which remains in operation today."

Verson's Walter C. Johnson says his company is sincerely interested in the development of turnkey systems: "Verson has developed several complete turnkey stamping operations. Our capabilities include engineering and building the presses, dies, material handling, etc. Actually we will start with a blueprint of a part and build the entire system including production of tryout parts."

Keeping noise under wraps, this press enclosure reduces the noise level a full 20 dBA at the operator's station. Engineered and built in Germany, the enclosure houses a 350-ton lamination press producing stator blanks at the rate of 350 spm

The need for potential press buyers to place greater confidence in their field representatives is proposed by H. Stanton Cheyney of Niagara. He claims: "Field representatives have a wealth of information and a substantial backlog of experiences. This invaluable data is available to assist their customers. However, in a large majority of instances, customers are reluctant to confide in their field representative, and fail to take advantage of the knowledge available. A press buyer should trust his representative by providing all of the data pertinent to the proposed stamping operation if he is to gain the maximum advantage from a new machine purchase."

PLASTIC MOLDING

Plastic molding has been the fastest growing segment of the forming industry. Two of the primary factors contributing to this tremendous growth are the wide array of materials coupled with the wide selection of manufacturing processes. For the moment, it appears that this growth pattern will soon slow down. The crude oil crisis is creating a shortage of raw materials for plastics. Its severity is being debated, but there's the possibility the plastic industry will have to be content to postpone its dramatic and inevitable upsurge. Already some manufacturers are working on product redesigns to convert to die castings if it becomes necessary.

Why Plastics Grow in Popularity. Technological advancements in both materials and process equipment have helped the plastic industry leap-frog to its present position. Some of the most important manufacturing advantages include:

- predictable surface finishes without machining
- high-speed, highly productive processes
- built-in color capabilities without painting
- ability to produce an unlimited variety of contours and sizes
- repetitive production capability within .003-in. at economical costs
- low weight-high strength radio
- wide material selection
- minimum scrap loss coupled with low cost scrap handling
- minimal in-process material inventory.

These advantages have enticed nearly every industry into using plastic materials, and, in recent years, a strong trend by medium- and large-size manufacturing com-

panies has been to add plastic processing to their production operations. It's a safe bet that those who don't have plastic operations are considering them.

The most significant factor in the switch to plastic processing operations is that most manufacturers have integrated the machinery with their present operations. Their general attitude is that plastic processing is a completely normal production operation and easily able to co-exist with traditional metals processing/assembly operations.

Some examples of integrated metal and plastic production operations include Parker Pen Co., International Business Machines Co., Saginaw Steering Division of General Motors Corp., Whirlpool Corp., and many more. The opposite approach, however, is also being used. Ford Motor Co. concentrates much of its plastic processing operations in its Saline, Mich., plant. One General Motors' operation in Syracuse, N.Y., operates over 100 plastic injection molding machines producing over 1200 different parts for automobiles, although several other plants within the corporation also process plastic materials.

Among the companies getting into manufacturing of plastic parts is Victor Comptometer Co. Reports Robert Sparkes, assistant vice president, manufacturing: "We are just beginning to manufacture plastic parts, and have bought a variety of plastic injection molding machines. Numerous small parts and exterior housings have been converted to plastic materials. We expect to gain improved and economical exterior finishes along with a worthwhile appearance feature. However, we are continuing to buy several small parts because our plastic machine capacity is presently very limited."

The materials shortage is worrisome to Richard Huber, general manager, Admiral Corp.: "A severe shortage of plastics would be absolutely disastrous for us. And we do not have a viable substitute material. The past transition from other material to plastics required 10 to 12 years to achieve customer acceptance. I don't want to even think about going back down that road again. If it happens, I think an acute material shortage will set the plastic industry back several years."

John S. Secker
Micro Switch Division

Another manufacturer with a product line heavily committed to plastics is Micro Switch Division, Honeywell, Inc. John S. Secker, assistant general manager, says: "So far, we have not experienced a shortage of plastic resins. However, a large portion of our products are designed to be plastic molded, and a serious shortage would result in a large problem. Our materials engineers are researching different types of plastic materials for specific parts in the event the material shortage becomes more serious."

Despite the materials shortage, materials producers, users, and machine builders are continuing with their development programs.

Automotive engineers are evaluating the manufacturing feasibility of door panels, hoods, deck lids, instrument panels, seat backs, etc. While particular type of plastic and production processes have not yet finalized, in every instance, the likelihood is that the largest size parts will be made of structural foam.

Appliance manufacturers also are engineering larger-size components to be made from plastic materials. Residential laundry equipment may soon have one-piece molded plastic cabinets. Many office machines now have one- or two-piece molded housings and others are slated to appear in the near future. Also, large housings for cooling fans and window-type air conditioning units are being molded of plastic to provide improved appearance, reduced weight, longer durability, and less noise transfer.

What's Ahead. The trend to larger-size plastic parts necessitates larger plastic molding machines. Users are buying or investigating molding machines in the over-500-ton capacity with clamping speeds in the 1000- to 1800-ipm range. Although accessibility to the operating controls has been a difficulty with large machines, newly engineered plug-in remote control operator panels are alleviating that problem.

Builders of plastic molding machines are making significant technological improvements. Among these are computer-controlled injection molding machines, twin screw extruders, higher tonnage, larger platens, faster injection, reduced operating noise, and safety features.

Another interesting and significant development in the equipment field is the entrance of two big "metalworking" names—Cincinnati Milacron and Ex-Cell-O Corp.

Cincinnati Milacron began building injection molding machines and extruders in 1968. Presently, the company builds injection molding machines of from 150- to 3000-ton capacity and is enjoying about 20 percent of the market. A recently developed injection molding machine with a twin screw extruder is making significant inroads in the PVC pipe production area.

Ex-Cell-O Corp. became the newest name in the plastic machinery business in mid-1973. The company's line includes machines for extruding, injection molding, vacuum forming, blow molding and foam molding.

Commenting on Ex-Cell-O's mar-

Ex-Cell-O's James Koontz displays an experimental auto instrument panel produced by the structural foam molding process. Advantages include light weight and high strength factors in addition to low cost

ket position, James L. Koontz, group vice president, machine tools, claims: "Ex-Cell-O is a viable competitor in the plastic machine business. Our broad line includes machinery for five of the six major plastic processing operations; we are not in the rotational molding area."

With respect to technological advancements, he says: "Thus far we have doubled the injection rate on the Ex-Cell-O-Jarecki foam molding machine; it has the fastest injection speed presently available. Although injection speed is not directly responsible for cycle speed, it is related and the fast speed contributes to worthwhile productivity improvements."

An old-line plastic machine builder, meanwhile, is not standing still. The Plastics Machinery Division of Beloit Corp. recently added the Beloit/Siemag structural foam molding machine to its line. The structural foam molding machine ranges from 75- to 500-ton clamp capacity with a shot capacity varying from 4 lb to 55 lb. The machines utilize a low-pressure injection cycle using a chemical blowing agent.

A. L. Maricco, vp and general manager of the division, says: "Our structural foam molding machine provides a true injection molded surface with a foamed core. The injection rate is powered by a nitrogen over oil piston-type hydraulic accumulator capable of completing a 40 lb shot in less than two-tenths of a second. The fast injection cycle actually explodes the shot into and fills the mold before the foaming cycle begins. Subsequently, foaming begins in the center of a mold and continues outward to a mold's surface, in contrast to the foaming starting during the fill cycle. This fast injection cycle provides uniform density, high quality and consistent surface finish, and uniform cellular structure.

"A customer using a Beloit/Siemag machine is structural foam molding a pair of 14-in. diameter wheels for a tea cart in one shot. The eight-spoke wheels, with a finely simulated wood grain, are molded within a 3.5-minute cycle to a PS density of 63," he reports.

Another seasoned plastic machinery builder, HPM Division of Koehring, recently activated a 14,000-sq-ft plastic production laboratory aimed at helping customers. It provides complete commercial-scale systems for plastic extrusion, injection molding, and extensive polymer mixing.

Most of the lab's projects involve proprietary programs for machine customers and materials suppliers. Some recent projects include an injection molded auto engine oil pan, and a semi-hollow extruded auto bumper. Equipment development projects include a vented injection system for ABS, acrylic, and nylon materials. The lab also is conducting an extensive program aimed at reducing the noise level of plastic processing machinery. Flexible hydraulic lines, vibration dampeners, partial enclosures, component isolation, etc., are being investigated and evaluated.

Another prominent equipment builder, Reed-Prentice Division, Package Machinery Co., recently completed a $5.5 million plant expansion adding 160,000 sq ft to its plastic machine building facility. The company offers a complete line of reciprocating screw injection molding machines along with machines for insert molding, blow molding, and thermoset molding.

Larry Bauer, sales manager, claims: "Several significant developments have been incorporated into the full line of our injection molding machines. General Electric PM-1000 Flo-thru logic solid state controls now are standard equipment. This control system provides precise repeatability, and is compatible with the variety of optional process control systems offered on our new machines.

"Our improved machine drive system provides the maximum horsepower from minimum electrical power input. These machines have the lowest horsepower to tonnage rating in the industry, and it is attained without sacrificing production or plasticating capacity. A uniquely engineered system also provides a true 16-to-1 ratio of the extruder screw during the reciprocating sequence."

DIE CASTING

Die casting is another area of the forming industry that is progressing rapidly despite problems with raw materials availability and price. Improved metal alloys, faster machines, and refinements in the die casting dies have contributed to extended use of die castings. Moreover, the recent petroleum crisis threatening a disruption in plastic materials production is contributing to a major up-swing in die casting's popularity.

Commenting on the die casting industry growth, Ex-Cell-O's Koontz says: "I thought die casting had about reached its peak. However, the energy crisis has removed the lid. Manufacturers are converting to die cast parts, and there is little die casting capacity available. Therefore, more customers are

buying die casting machines."

Regarding technological developments, he reports: "B&T Division is working on a Vertical-Cast-Trim machine to effectively provide an integrated die casting system. Advantages will include one machine requiring less floor space, eliminated machine-to-machine handling, etc. Initially, we are considering the new machine for smaller-size high-volume parts; later on, we may progress into the larger-part area.

"We are also researching a hot chamber magnesium die casting machine. We have worked on it for about three years in conjunction with a material supplier. However, now Ex-Cell-O is going it alone. A prototype machine is being used to evaluate production problems including environmental control, etc. The 1250-degree temperature of molten magnesium, however, causes problems with the machine's shot sleeve, shot cylinder, seals, valves, etc., that must be ironed out prior to consideration of a production model."

Ex-Cell-O Corp.'s B&T Division produces die casting machines of up to 2500-ton capacity. One is die casting two cylinder blocks for Chevrolet's Vega engine in one shot. ■

useful literature

Equipment for plastics processing is described in several publications available from Beloit Corp.: Low-pressure injection molding machines for structural foam.

Twelve pages. *Indicate No. 707 on card.* **Accessory equipment** for the plastics industry. Twelve pages. *Indicate No. 709 on card.* **Continuous dryer** and preheater for granulated resin. Four pages. *Indicate No. 710 on card.* **Automatic vacuum hopper** loader for powders and granules. Four pages. *Indicate No. 711 on card.* **Ball and Jewell augerfeed** granulators. Four pages. *Indicate No. 712 on card.* **Unscramblers** for automatically separating parts and runners. Four pages. *Indicate No. 713 on card.* **Automatic hopper loaders** for all resins. Six pages. *Indicate No. 714 on card*

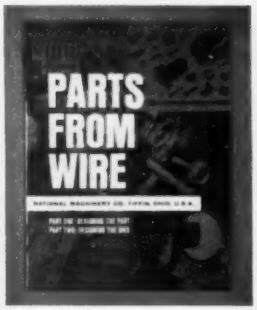
Reciprocating screw injection molding machines, injection blow molding systems, and insert molding

machines are described in a literature folder. (Reed-Prentice Division)
Indicate No. 715 on card

Transfer die technology is covered in a 40-page reprint of a series of articles.

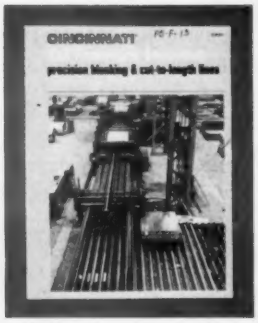
(Livernois Automation Co.)
Indicate No. 716 on card

Designing the part, and designing the dies, are discussed in a 22-page paper on cold forming parts from wire. (National Machinery Co.) *Indicate No. 717 on card.* **Upset parts** and materials, as well as the process and equipment, are



discussed in a 24-page brochure.
Indicate No. 718 on card

A number of publications concerning metal forming operations are available from Cincinnati, Incorporated: **Coil processing equipment,** including precision blanking and cut to length lines, are described in a



16-page brochure. *Indicate No. 719 on card.* **A management-controlled approach** to processing flat rolled products, described in an 8-page fold-out. *Indicate No. 720 on card.* **Press brake tooling,** including flip gages, stocked tooling, etc., is described in a packaged series of data sheets. *Indicate No. 721 on card.* **PM parts** with the strength of forgings. Eight pages. *Indicate No. 722 on card.* **Forging powder metal preforms.** Four pages. *Indicate No. 723 on card.*

The design of dies for upsetting forging machines is discussed in a 34-page brochure. (Ajax Manufacturing Co.)
Indicate No. 726 on card

Designing high-performance dies with Ferro-Tic steel-bonded carbide components is discussed in a 22-page

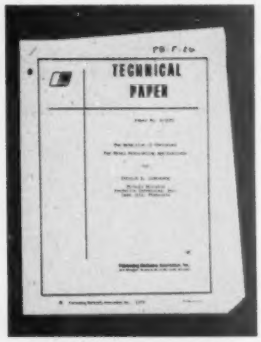
continued

useful literature

continued

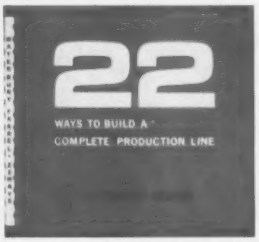
paper. (Sintercast) *Indicate No. 727 on card.* **A 16-page well-illustrated technical paper** discusses machinable carbides for high-performance tooling and wear parts. *Indicate No. 728 on card*

Five technical papers are available from Di-Arco/Houdaille on sheet metal forming with conventional press brakes and urethane: **Problems in sheet metal forming,** including press brake and associated tooling. Thirty pages. *Indicate No. 731 on card.* **Selecting the correct urethanes** for metal-forming and fabrication ap-



plications. Ten pages. *Indicate No. 732 on card.* **Basic principles of metal forming** with urethane. Thirty-eight pages. *Indicate No. 733 on card.* **Forming pre-finished materials,** such as painted coil and sheet stock, and highly-polished aluminum. Ten pages. *Indicate No. 734 on card.* **Tube fabrication** by hand bending and medium production power machines. Sixteen pages. *Indicate No. 735 on card*

22 ways to build a complete production line using transfer presses is presented in a 38-page brochure. (Waterbury Farrel) *Indicate No. 736 on card.* **The Heading Story** is told in a programmed self-instruction book of approximately 100



pages. Its "scrambled" format helps one to learn quickly and effectively. *Indicate No. 737 on card*

Roll form theory, tooling, applications, and related equipment are described in 28-page technical paper.

(Maplewood Div., Ex-Cell-O Corp./ *Indicate No. 739 on card.* **Roll forming machines** for heavy-duty and for high-production applications are described in a 12-page brochure.
Indicate No. 740 on card

Numerically controlled punching and notching machines for sheet metal fabrication are described in a 10-page technical paper. (Strippit-Houdaille) *Indicate No. 741 on card.* **Use of Wales tools** in medium- and high-production sheet metal fabrication is described in a 16-page technical paper. *Indicate No. 742 on card*

Bourdon tubing selection and spring design is described in a 14-page technical paper. (Handy & Harman Tube Co.) *Indicate No. 743 on card.* **Eccentricity in bench drawing seamless** and welded tubing is discussed in a 6-page technical paper. *Indicate No. 744 on card*

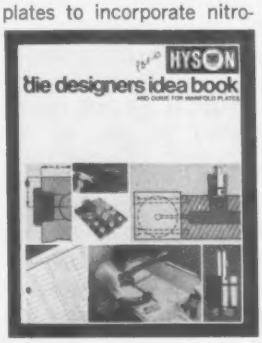
The Verson die manual contains 94 pages of valuable information on press brake dies and punching

attachments. (Verson Allsteel Press Co.)
Indicate No. 747 on card

The Impacter System can double or triple production for a forging operation. Heat, transfer and forge in

one continuous process. (Chambersburg Engineering Co.)
Indicate No. 748 on card

Looking for ideas? Send for the die designers' idea book and guide to manifold plates to incorporate nitro-



gen cylinders in place of die springs. (Hyson Division, Teledyne Corp.)
Indicate No. 749 on card

All you want to know about stamping and drawing sheet metal is explained in a 64-page three-section booklet. (Waterbury Farrel)
Indicate No. 751 on card

Roll forming profile ideas, a 24-page booklet, illustrates

130 examples of sections that can be roll-formed economically. (Lockformer Co.)
Indicate No. 752 on card

Uncommon approaches to metal forming are explained in a 12-page booklet with full color illustrations. The

expanding, shrinking and rotary roll forming processes are detailed. (Grotnes Machine Works)
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Introduction to the four slide process for wire and strip forming is given in Nilson's 8-p. brochure.
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Machine Builders and Buyers—

Eyeball to Eyeball

"Machine tool people are lazy. They don't want to touch something they've never done before. We are getting little response from them on special projects."

"Customers are dictating process, machine design and equipment configuration. This does not allow the machine tool builder to offer his experience and ingenuity."

These contradictory statements by a multi-plant, multi-product manufacturer and a builder of special transfer machines, respectively, are indicative of a chasm of general misunderstanding that exists between two groups who, for the good of both, should be singing the same song in closer harmony than a barber shop quartet.

Over the past several months, scores of manufacturing people from every metalworking industry have been asked: "What could machining equipment manufacturers do to help your operation become more productive?"

And their counterparts, the machine and cutting tool manufacturers, have been asked: "What are the most common mistakes your customers make in purchasing the equipment you build?"

Here are the resulting comments by both. Taken separately, they are merely complaints; taken together, they indicate that something constructive can be done to enrich this relationship and enhance the productivity of this nation's metal-cutting industry.

The Buyer's Point of View. "With products that we consider to be proprietary, heretofore we have been reluctant to bring machine tool people into our plants. We are now doing it. We are letting out more information than we ever have before in an attempt to solicit their cooperation. But when you've made six or eight phone calls to find out when the builder's people are going to come back to further discuss a project, and you get little or no response, it's discouraging."

The words are Robert N. Lindner's, manager, Manufacturing Services, Borg-Warner Corp., Chicago, Ill. And they are echoed by Charles Eberhardt, manufacturing manager, Caterpillar Tractor Co., Aurora, Ill., who says: "We need more and more of the equipment suppliers getting in with our problems. We have no reluctance about discussing the product, but we find the suppliers give us a lot of lip service and don't give us as much physical participation as we would like."

Dissenting with this concept,

Robert N. Lindner
Borg-Warner Corp.

however, Jerome J. Kriva, vp-manufacturing, Hydraulics Components Division, Rexnord Corp., Racine, Wis., says: "I think you tend to give away your own art when you ask the equipment specialist to come in and conceive for you. As soon as he conceives for you, he can conceive the same

Judson T. Brown
Gilson Brothers Co.

thing for your competitor—and you've lost part of your edge."

Another point is raised by Judson T. Brown, director of manufacturing, Gilson Bros., Plymouth, Wis., who remarks: "One thing the equipment supplier could do for us is not oversell their equipment as to what it will do. A fair amount of them are realistic in this respect, but then there are others who go overboard in promising things they can't deliver. You have to sort out in your mind how much you have to discount what the various vendors tell you."

In agreement with Brown is John S. Secker, assistant general manager, Micro Switch Division,

Honeywell, Inc., who adds: "I think there is a common belief that everything is purchased on price, and I don't believe that is really true."

The Machine Builder's Point of View. "One of the most common mistakes our customers make is not utilizing industry knowledge for the best process," says a spokesman for F. Jos. Lamb Co., Detroit, Mich., a prominent builder of sophisticated transfer machining lines. "And buying on the basis of price alone," he adds.

According to Richard P. Cottrell, vp-marketing, Cross-Fraser Division, Cross Co., Fraser, Mich., also a transfer machine builder, "Some customers are not open for options or alternate proposals. Many do not allow sufficient lead time for the preparation of proposals. They are requesting 'sealed bids' with firm due dates and no extensions. This, at times, does not allow enough time for a concentrated study of process and costs."

Cross-Fraser sales personnel agree with Lamb that machinery purchases are being made on a price basis instead of analyzing potential long-range savings from a higher initial investment. This can be caused, they contend, by underestimating project costs or by lack of communication between purchasing, process, manufacturing, and maintenance departments.

National Acme's VP-Sales Ralph J. Spresser comments: "A basic need from customers are 'in-process drawings' and 'part-in and part-out drawings' (chuckers), and generally more understanding on their part about the cyclical nature of the machine tool business so that they can better plan for new machine purchases in accord with the time element."

Jack J. Lichtenberg, vp-sales, Eldorado Tool & Manufacturing Corp., Milford, Conn., says: "Our customers, unlike those who purchase grinders, lathes, milling machines, etc., are buying a complete hole drilling process, and that is what we try to make certain we provide."

Although a host of new cutting tool materials are available for jobs like these on the multiple-spindle automatic, many users are reluctant to use them for reasons that range from price to labor resistance

The Editor's View. Machine buyers seem to be pleading for the machine builders to take more interest in their problems. They seem to want more creative engineering from their suppliers, they want faster reaction to their requests, they want builders to exhibit more integrity, and they would like their machine purchases to be cloaked in secrecy.

At the same time the machine builders are asking for a little more understanding of the problems confronting them. They're asking for customer consideration of their needs in terms of time, product design information, firm commitments, cooperation in planning, and realistic project cost projections.

Essentially, the complaints of both groups probably could be considerably diminished through better communications. Robert C. Bevis, vp-machine tool marketing, Cincinnati Milacron Inc., reinforces this view with these words: "The idea of a more meaningful dialogue between users and vendors is a philosophy we at Cincinnati Milacron have been voicing for at least the last ten years.

"For such discussions to be fruitful it is essential that they begin much earlier in the user's purchasing cycle than they do today; furthermore, the vendors must be given greater access to product design engineers to suggest alternative processing. On the other hand, to avoid a great waste of time, vendors must have more knowledgeable and better trained field sales personnel than they have ever had.

"Many vendors are not using the input on problems they could receive from their own demonstrators and field service personnel. Probably the most important dialogue occurs in the user's shop between operating personnel and vendors' servicemen. In many cases this information is ignored by both vendor and user. Both parties have the responsibility for problem solutions that are not only beautiful in concept but are practical and reliable for use in the specific plant environment."

What One Company Did. Earlier this year, a multi-plant manufacturing company primarily engaged in producing automotive components took a big step toward establishing better communications with its machine equipment suppliers.

The company's general manager, works manager, and manufacturing engineering manager paid visits to all its transfer machine suppliers for the purpose of discussing how the transfer machine builders might do a better job for them. This company has an outstanding growth record, and over

the years has purchased more than 40 transfer machines. Excerpts from its presentation to the machine builders follow:

"A study of the downtime on all transfer machines in our division prompted this visit. We found the downtime ranged from 20 to 50 percent. We are doing something about the part we can control. This study also pointed out some of the things causing downtime that our shop people have no control over. This, coupled with observing the start-up problems of several new machines, prompted us to try to put our story together and request this opportunity to talk with you about it.

"We expect all vendors to quote on the basis of making a fair profit on a machine built to adequately manufacture the part to be machined. It is not to our advantage to put vendors in the position of having to skimp on design in an effort to make a profit. We are also very much opposed to a prospective supplier quoting a low price and planning on making it up on changes.

"Our studies of our transfer machine problems put the spotlight squarely on 12 specific areas where improvements can and must be made. Individually, but not necessarily in order of importance, these are:

"1. Closer contact should be maintained between the sales engineer and our people after the order has been placed. We should be a party to the vendor's design plans at an earlier stage than normally occurs. Instead of reviewing a steady flow of design layouts, etc., usually we see nothing of design until detailed approval prints are brought in, along with a threat of extending delivery if the designs are not approved quickly. This tends to limit our design control, especially on short lead time jobs. We also note a lack of communication between vendor estimating and design groups on occasion. This is an area the sales engineer should coordinate immediately after an order is received. Quotations, at least 'not to exceed' prices, must be quickly established for all proposed design changes so that we have a chance to evaluate the economic worth.

"2. We need more realistic delivery promises. We must be able to count on and plan on promises made.

"3. We need and demand good service. In past instances, we have asked for service on an emergency basis and have ended up solving the problems ourselves before the serviceman arrives.

"4. Generally speaking, transfer machine vendors' in-plant inspection, receiving inspection, and metallurgical controls are poor, in our opinion. Typical problems include: spotty hardness on rails; pallets containing dimensional errors that weren't discovered until the machine was assembled and we were trying to run pieces, and other cases where the error was not discovered until a new detail was put on. Most of these errors were corrected by the vendor—sometimes at great expense—but they also prevented us from making pieces that may have been sorely needed.

"5. We need transfer machines that go together faster and debug in a shorter period of time. We are putting all our transfer machines on monitors and, in the not too distant future, when we get a new machine it will be hooked to a monitor to aid in the debugging.

"6. We like mechanical feeds, and some of our vendors have done a better job than others on the clutch and brake arrangements. Some are farther along on a satisfactory method for spotfacing. We like the mechanical index. It should solve a lot of problems we've had. Some vendors furnish a better transfer bar than others. Pallet cross-overs and corners have been a problem on a number of machines.

"7. Drill heads need improvement in the bearing and sealing areas.

"8. Chips are a problem on most machines. A good coolant system must flush chips and wash all rails as well as to direct coolant to a cutting edge.

"9. Noise control should be a primary consideration in the design of the equipment and not just a patch-up job after the machine is completed. The ultimate way around the noise problem in our plants is to design the noise out of new equipment.

"10. Safety and ease of maintenance, which are inter-related, could be improved on every machine we own. Very seldom does anyone get hurt during a normal machine cycle. It always seems to be when they are doing maintenance work, or changing tools, or doing something outside the normal production cycle.

"11. Recently our chief control systems engineer made a survey of electrical problems on transfer machines for me. He reported that the control problems generally are external to the control enclosure. The four main areas of concern are: limit switch failure attributed to coolant; accumulation of chips on limit switches fouling actuation; coolant getting into motors which shorts out the windings or causes premature bearing failures; and broken drill detectors. Wherever possible, switches are located away from the coolant; but remote actuation has not been effective because the actuating device is more susceptible to sticking than limit switches due to gummy deposits. It appears that this is an area where everyone could stand improvement. Perhaps a different method of telling where the head is, or better chip and coolant guarding; and a good broken tool detector would help.

"12. Mist control has been a problem on all transfer machines.

"We don't know how to do all the things we have asked you to do, but we do have great faith in your ability as a supplier and we look forward to working with you for many years to come."

Others Verify. Manufacturing people from other industries veri-

fy many of the sentiments expressed in the foregoing presentation. And they're not talking specifically about transfer machines but about all kinds of machining equipment.

Donald Lorton, corporate director of facilities planning, Whirlpool Corp., Benton Harbor, Mich., says: "Any time you cut metal you're going to make noise. I haven't figured out a way to do that quietly yet, but there is no question that we in industry are going to be expecting machine tool people and press builders to sharpen up in this area."

L. Paul Williams, manager, manufacturing, Controls Division, Eaton Corp., says: "Probably the hardest thing we look at with a piece of automated or semi-automated equipment is 'How difficult is it going to be to keep it running?'. I'm not thinking of the reliability aspect, but if it does go down, what kind of genius do you have to have to send in there to get the thing back up and running? So on every piece of special equipment we have built for us, we want detailed drawings, detailed circuit diagrams; and we want it as modular as we can possibly get. We want very detailed maintenance instructions and troubleshooting manuals. And I would certainly welcome more help from suppliers of machine tools in the area of training maintenance people—and would be willing to pay for it."

The Customer's Share. Machine builders, on the other hand, point out that in many instances their customers are partly responsible for their own dissatisfaction.

A respected builder of transfer and other special equipment remarks: "Failure to train operator and maintenance personnel, both at the machine tool builder's plant and in their own plant, is very common. Our customers rotate their operating and maintenance personnel and create a condition where no one develops experience and knowledge to troubleshoot and maintain a machine to operate at its maximum efficiency. They should assign maintenance personnel to the machine during installation, tryout and acceptance of the machine at their plant, and these men should work with the machine tool builder's serviceman during this stage."

This machine builder also says that a common mistake customers make is to limit the design and configuration of a machine to an existing floor plan area and facilities so that it is necessary to compromise in the processing, tooling, tool change accessibility, material, operator and maintenance work areas. Another builder puts it even more succinctly: "A common mistake is crowding a machine because they do not have enough room."

Both these builders agree with several others that customers often do not provide an adequate volume of tryout parts and production inspection gages both while the equipment is at the builder's and during setup and debugging at the customer's plant.

F. Jos. Lamb Co. gave the customer's failure to buy additional work stations for future requirements as a shortcoming. And Cross-Fraser people commented that "It is common for purchasing departments to deviate from the original brand of tools without evaluating the cost of the lower tool life and, more importantly, the cost of the added machine downtime to change tools more often."

Opposing Views on NC Machines. "When you buy a sophisticated tape-controlled machine, we originally thought all you needed to do was load and unload it. The machine would do all the work. But it didn't turn out that way. The machine is not that smart. It takes a fellow who feels, and hears and knows that something is going on," says R. J. Keyser, vp-manufacturing, Fairbanks Morse Division, Colt Industries, Beloit, Wis.

Keyser adds that his company, however, is going to more tape

Julius Vetter
Louis Allis Co.

control as far as major machine tools are concerned. And, to increase the productivity of all machines, he says his company is going "to tool kitting for every job to eliminate the time spent hunting for tools."

He and Julius Vetter, president, Louis Allis Co., Milwaukee, Wis., agree that too many machines waste too much time "cutting air." Keyser remarks: "On a tape-controlled machine where the industrial engineer doesn't go out on the floor when the job is being run for the first time, and he's programmed it from drawings with possibly a mistake or two being made in the process, the foreman may stop the rapid traverse before he should, and it goes into the feed too soon and slows down the cycle."

Maintenance and training are other problem areas prompting critical comment from users of NC machine tools.

"Standardization is the first step you have to take," says John Sedoric, vp-manufacturing, Paper Machinery Division, Beloit Corp. "Compared with those of five years ago, the controls have changed dramatically. If you have a variety of different controls made by different people, you need an electronics engineer to maintain them.

"We've standardized our NC controls on General Electric. They have well-trained people who respond, and they have a training center where we can send our own people. However, seniority is a problem. The older employee

John Sedoric
Beloit Corp.

sometimes is entitled to the job over a younger, better qualified man. We've had to establish a separate classification just for that group.

"And while we have concentrated on GE controls, we feel we can live with two different systems. Whenever we buy enough of a particular kind of machine so that we can afford to train people on it, we can and will."

"We have a hodgepodge of NC controls," says C. D. Seidler, manager, New Products Planning, Teletype Corp., Skokie, Ill. "If we standardized, the servicing would be easier, the training simpler, and all the rest of the things that go with it."

Computerized Diagnostics. Generally speaking, NC machine users feel that maintenance and the training of maintenance men are the biggest problems they have with this equipment.

"But," says a spokesman for Kearney & Trecker Corp., "while it's understandable that users of NC machining centers, for instance, would like to see a comprehensive approach to NC maintenance—perhaps a 'cook book' approach that would cover all models and types—it's not possible. There are too many variables to consider. Some of our newer models do include some computerized diagnostics, but we're a long way from total maintenance diagnostics at this time."

An alternative approach, however, has been adopted by Marley Co., Olathe, Kans. This company replaced several three-head boring mills with two Milwaukee-Matic IIIB's several years ago. The machines are used to produce precision cast iron gear boxes for Marley's line of cooling tower equipment. Tolerances, in some cases, must be held to less than .001 in. between perpendicular shafts, and machine alignment as well as function is critical.

Plant Manager George Hopkins reports that the NC machines have increased productivity about 20 percent, and that proper machine maintenance has been an important part of the achievement.

"Let's face it," he says, "Machining center maintenance requires at least two basic skills—mechanical and electronic. It is rare that both of these can be found in one person. If we invest in thorough training for such an individual, there's no guarantee that he'll stay with us long enough to make it pay off.

"What we're doing is to rely on Kearney & Trecker's service department for anything major, and letting them train our men on-the-job as they go along. After some elementary training at K&T, our men are able to handle most of the routine maintenance on the machines. Then, about every two or three months, a K&T service man comes in to fully inspect and service the machines. Our men accompany him so that his visit serves the dual purpose of servicing the machines and training our men at the same time.

"This approach is paying dividends because our men already are handling the majority of problems that arise."

Hopkins and Works Manager Ted Dickey believe they are getting the maintenance job done without a lot of fanfare and wasted effort in a reasonable time frame while gradually and realistically training their own men. Both agree, however, that if others adopt this approach: "It is important to buy the machining centers from manufacturers with reliable service departments."

Almost echoing the sentiment expressed in this last statement is Robert H. Yanker, plant manager, Barber-Green Co., Aurora, Ill., who says: "We've just had a tremendously good experience when we bought an NC turning center from LeBlond, and they really went overboard as far as training our people is concerned—operators, programmers, and maintenance people."

Adaptive Control. Earlier on, the wasted time caused by "cutting air" was mentioned as an area that should receive more attention. Also several of the manufacturing people interviewed remarked that the use of maximum feeds and speeds could improve productivity on almost every kind of machine tool including grinders, lathes, milling machines, etc.

Efforts are being made to take both these factors out of the hands of humans and put them into the machine tool's control system. Boeing's Aerospace Group has developed such a control system and Westinghouse has also made some major breakthroughs in this regard. These automatic systems which are capable of sensing tool-to-work position, force against tool in the work, vibration, and spindle power, and then feed such signals back to the control system so that optimum lengths of travel in rapid traverse and optimum cutting speeds and feeds are attained, are but one step away from popular acceptance.

As a matter of fact, the University of Michigan's Industrial Development Division predicts that by 1977, one-fourth of the new machine tools being produced will have adaptive controls as standard equipment.

Cutting Tools & Coolants. Though some of the newer cutting tool materials have attracted many of our interviewees, few have wholly accepted them for a variety of reasons:

"We've investigated some of the new tooling materials like UCON and ceramics, but because of op-

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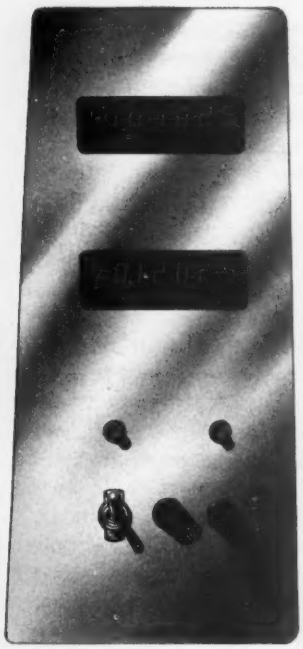

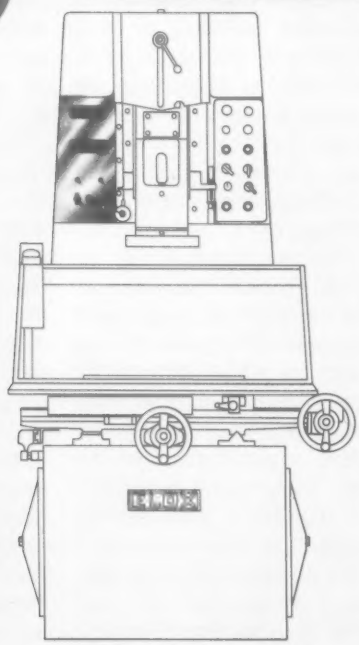

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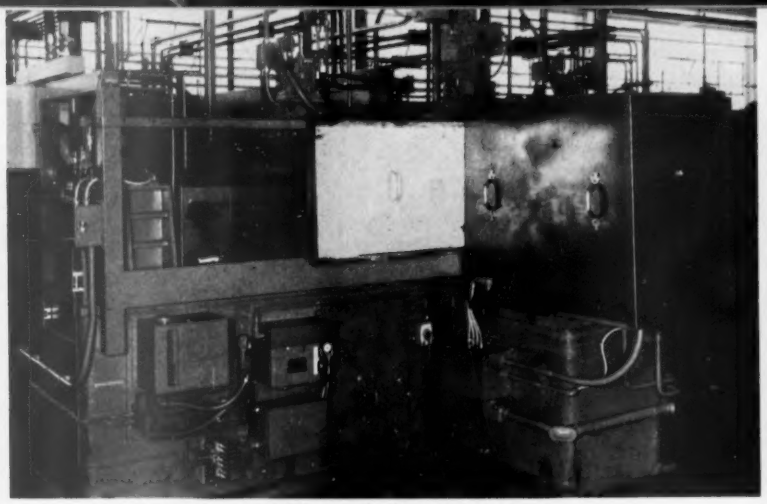

On transfer machines such as this, Snyder Corp. has used a "totally enclosed" concept. The machine operates at a noise level of 80 dBA, substantially under the 90 dBA required by OSHA

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erator acceptance, we'll stick with our present tool materials."—Thor's James McCarthy.

"We're going to specialized cutting tools; the throwaway types with special coatings. We've tried UCON, and found it to be very brittle."—Fairbanks Morse' R. J. Keyser.

"About 60 percent of our throwaways are titanium, but we're often asked 'What do you get back for it? How much faster are we running?' So we have to get that information into our industrial engineering department so that they change the feeds and speeds to use it adequately."—Beloit's John Sedoric.

"We've had the Carboloy people in with their Computerized Machinability Program, but we have a union problem in that we cannot use feeds and speeds as a reason for changing our incentive rates, so I can't justify it."—Louis Allis' Julius Vetter.

"We tool mostly with standard carbide. We have a list of approved tool bits, and the purchasing department follows this list in negotiating with suppliers. If we get a specific tool that does a better job, we have no hesitation about specifying it. Our manufacturing supervision, toolroom people, and manufacturing engineering people decide on our tooling. —Falk's Henry Knauth

"In regard to all the new materials, you need rigid machines and the horsepower to use them to advantage."—Caterpillar's Charles Eberhardt.

Concerning supplier relationships, Yanker had this to say: "Deliveries have slowed, but the big problem is that where our established vendors used to carry our inventory on their shelves, now they want a firm commitment from us, and we end up keeping more tooling on our own shelves."

McCarthy, on the same subject, remarked: "We pretty well restrict ourselves to several vendors, and we find that not only do they come through for us a little better, but operator acceptance is better also."

None of our sources had much to say about experiences with various coolants except in regard to problems with misting and with disposal of waste coolant because of local EPA requirements. Perhaps the fact that these two problem areas were the only ones mentioned, makes their significance even more obvious.

Henry M. Knauth
Falk Corp.

Machining

Developments To Look for in '74. Many machine tool builders are moving toward solutions to some of the problems mentioned earlier by manufacturing people. Tom Shifo, manager, applications engineering, Sundstrand Corp., reports that his company is moving ahead on several fronts to increase the productivity of its present stable of machines.

"Primary emphasis will be on controls," he says. "Our SWINC has been a quantum step forward in improving producitvity, and there are other improvements we can and will make in this control plus some new techniques and innovative applications of it.

"We are experimenting with adaptive control, and the benefits are obvious—decreased cycle times and optimum tool life. However, in a machining center environment, we must control the sensitivity of the transducers to accommodate the wide variety of tools used. This is the problem we're currently working on.

"In the area of machine design, we're just now beginning to see the results of a recent development project—our Series 80 Omnimils. These machines are bigger and heavier and of all-steel construction. They can move at 400 in. per minute—twice as fast as the machines they supersede. As a matter of fact, we're changing the image of the machining center by increasing all its capabilities. By giving it the ability to compete with single purpose milling, drilling, and boring machines, it can find applications in higher volume production situations."

Cincinnati Milacron's Robert Bevis says: "We are continuing our developments so that our products will not only be more reliable, but can be operated by and most importantly maintained by a greatly reduced skill level.

"To insure that we do everything possible to solve today's and tomorrow's problems, we are not only listening more and more intently, we are also increasing the

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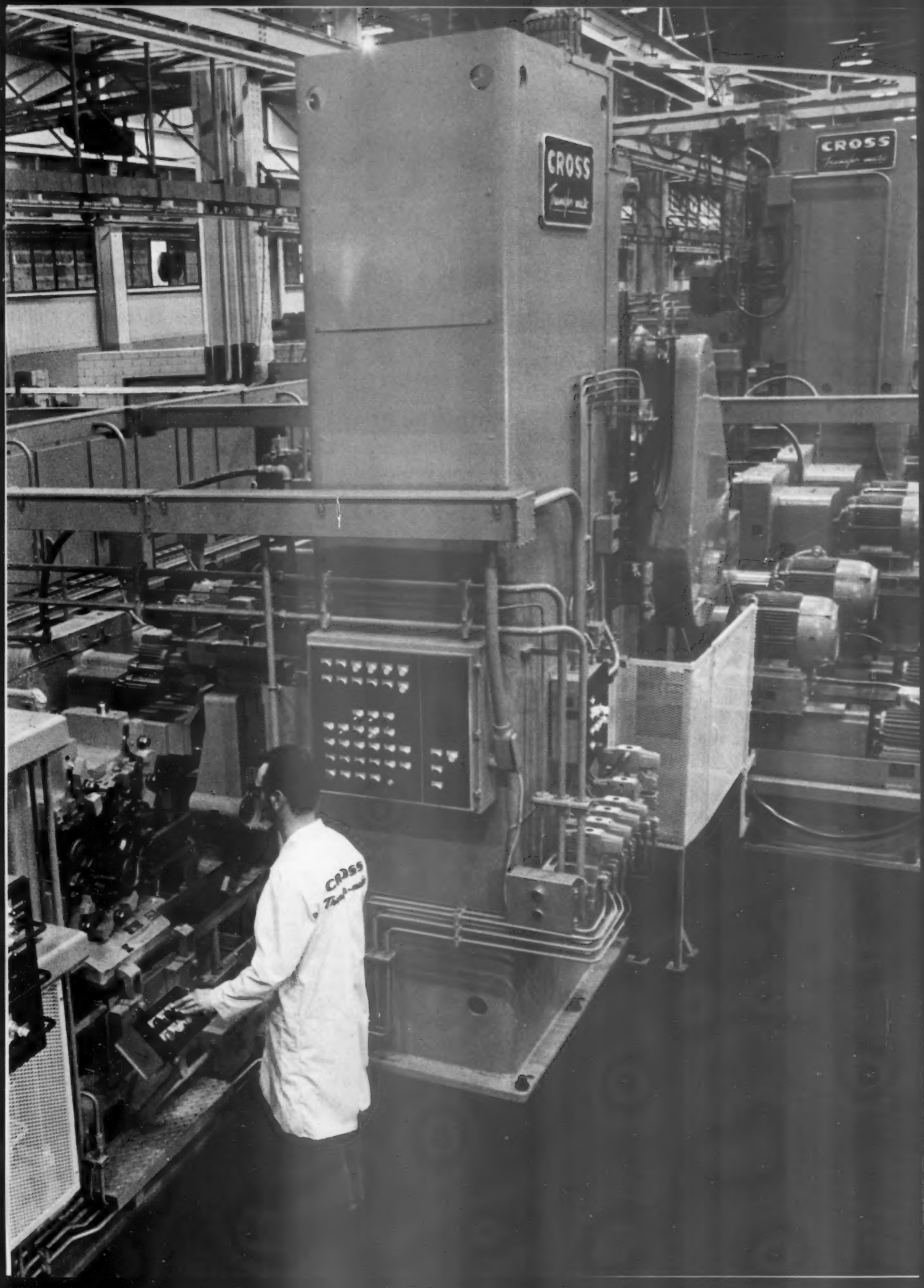
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And it still is. But we're not referring to the "make-it-work" headaches of the business. We're talking about a different kind of trying.

Like trying to see our customer's problem in terms of his needs. And trying to find the best solution for him, not us. This machine is a good example of what we mean.

We built it for a leading producer of earth-moving equipment. And although it looks like a typical high-production transfer machine, it isn't. It produces either one of two different engine front covers, at a rate of 38 per hour. And it proves that with a little trying, transfer machine efficiencies can be applied to low production needs.

By simply re-arranging our standard building blocks and using some imagination, we came up with a machine that fits this customer's needs today, and that can be easily expanded for future production increases. It looks like its automotive counterpart because it uses the same feed units, transfer drives, pallets, bases, and heads. The only difference is the arrangement, and the company that did the arranging.

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amount of time our engineering, proposal, and marketing research personnel spend in customers' plants observing and questioning."

In regard to OSHA regulations, particularly in the area of noise control, Snyder Corp., Detroit, is and will continue to concentrate on building transfer machines that do not exceed 85 dBA. Howard Maynard, president of the Detroit firm, says: "Every job we get from one of the major automobile makers specifies that the equipment must not exceed 80 dBA. It's a tough task to meet this standard because even if all the components operate at under 80 dBA, when you put them all together you compound the noise factor."

Late in 1973, Snyder delivered a 23-station automotive piston weight milling transfer line that met its customer's noise specification through the use of a "totally enclosed" concept that actually boxes in the transfer line, its machining heads, and hydraulic units.

Many machine tool builders report they will be adding new types of machines to the traditional lines they manufacture. Tom Carroll, president of Master Machine Tools and Johnson Drill Head companies of Hutchinson, Kans., reports that plant facilities have been expanded by 20 percent, and that product development projects presently in the prototype stages include vertical multispindle drilling machines, antifriction slides and a new line of automatic drill units.

Machine builders also will be showing more interest in peripheral equipment. For instance, George H. Holz, president of Snow Manufacturing Co., Bellwood, Ill., says Snow had added a "pick and place" robot to its line of drilling and tapping equipment. Called the "Minitron," the robot can be used for automatic feeding of parts which must be preselected and placed into a tooling nest for subsequent machining. This unit can be used on a wide range of machines including centerless grinders and automatic screw machines. ■

TEN COMMON PROBLEMS OF MACHINE PURCHASERS

1. Poor communications and lack of mutual understanding between vendor and purchaser.
2. Delivery (insufficient lead time allowance, unrealistic delivery promise).
3. OSHA and EPA regulations (noise, safety, pollution).
4. Machine accessibility (insufficient floor space available for maintenance, tool changing, material handling).
5. Inadequate service provisions (air, water, electric, coolant, chip disposal, foundations, conveyors, etc.).
6. Lack of maintenance information and training, spare parts, and details.
7. Tryouts (lack of sufficient parts, gages, etc., to permit adequate compliance runs and debugging at builder's plant).
8. Standardization (tools, control systems, etc.).
9. Capability and capacity (including both maximum part size and cycle time).
10. Machine reliability and reputation of vendor for service.

useful literature

A comprehensive 84-page guide to spindles for grinding, milling, boring, ECG, and drilling has dimensional

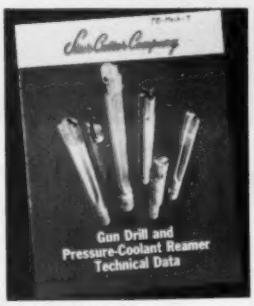
drawings, application photos, and selection and engineering data. (Setco Industries, Inc.)
Indicate No. 401 on card

"A New High Speed Tool—"Ucon" Indexable Inserts" and "A New Concept in Cutting Tool Materials" are the titles of two papers dealing with the composition, properties, and the performance of Ucon inserts. Ucon is a new high-speed tool for use in applications now served by C-5 through C-7 grades of carbide. (Union Carbide Corp.)
Indicate No. 402 on card

Technical bulletins describe use of Max-I-Shear rougher-finisher face mills for ma-

chining 1020 steel, cast iron, and stainless steel, citing actual case histories of demonstrations. (Ingersoll Milling Machine Co.)
Indicate No. 406 on card

Gun drill and pressure-coolant reamer technical data is presented in a 22-page bro-



chure. Includes information on resharpening and feeds and speeds for various materials. (StarCut Sales Inc.)
Indicate No. 407 on card

Unground-form hobs for gears, work wheels, splines, serrations, sprockets, and special forms are described

in a 16-page brochure which includes cost advantages, types, tooth forms, and other information. (StarCut Sales Inc.)
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continued on page 67

Go
The Cleveland Route...

For Wide-Scope Coverage In Metalworking Tools And Machines

Cleveland Twist Drill has one major business objective . . . we devote *all* our skill, experience and facilities to supplying industry with top-quality, high-performance cutting and threading tools, precision slides, machines for threading, for profile grinding and diamond wheel dressing and for carbide drill pointing. After 97 years of problem solving, we've made a total commitment to anticipate urgent needs of the metalworking industry with wide varieties of skillfully-engineered, high-quality tools and machines. All from one responsible, proven source.

Our size, service, product coverage and distribution network set us apart as a potent, still-growing marketing force in industry. When you have a metalworking need . . . go the Cleveland route. Contact your Cleveland Industrial Supply Distributor or The Cleveland Twist Drill Company, Box 6656, Cleveland, Ohio 44101.

CLEVELAND TWIST DRILL

An Acme-Cleveland Company

CLEVELAND

Distributed in world markets from manufacturing plants in:
United States • Mexico • West Germany • Canada • Netherlands • United Kingdom

continued from page 59

amount of time our engineering, proposal, and marketing research personnel spend in customers' plants observing and questioning."

In regard to OSHA regulations, particularly in the area of noise control, Snyder Corp., Detroit, is and will continue to concentrate on building transfer machines that do not exceed 85 dBA. Howard Maynard, president of the Detroit firm, says: "Every job we get from one of the major automobile makers specifies that the equipment must not exceed 80 dBA. It's a tough task to meet this standard because even if all the components operate at under 80 dBA, when you put them all together you compound the noise factor."

Late in 1973, Snyder delivered a 23-station automotive piston weight milling transfer line that met its customer's noise specification through the use of a "totally enclosed" concept that actually boxes in the transfer line, its machining heads, and hydraulic units.

Many machine tool builders report they will be adding new types of machines to the traditional lines they manufacture. Tom Carroll, president of Master Machine Tools and Johnson Drill Head companies of Hutchinson, Kans., reports that plant facilities have been expanded by 20 percent, and that product development projects presently in the prototype stages include vertical multispindle drilling machines, antifriction slides and a new line of automatic drill units.

Machine builders also will be showing more interest in peripheral equipment. For instance, George H. Holz, president of Snow Manufacturing Co., Bellwood, Ill., says Snow had added a "pick and place" robot to its line of drilling and tapping equipment. Called the "Minitron," the robot can be used for automatic feeding of parts which must be preselected and placed into a tooling nest for subsequent machining. This unit can be used on a wide range of machines including centerless grinders and automatic screw machines. ■

TEN COMMON PROBLEMS OF MACHINE PURCHASERS

1. Poor communications and lack of mutual understanding between vendor and purchaser.
2. Delivery (insufficient lead time allowance, unrealistic delivery promise).
3. OSHA and EPA regulations (noise, safety, pollution).
4. Machine accessibility (insufficient floor space available for maintenance, tool changing, material handling).
5. Inadequate service provisions (air, water, electric, coolant, chip disposal, foundations, conveyors, etc.).
6. Lack of maintenance information and training, spare parts, and details.
7. Tryouts (lack of sufficient parts, gages, etc., to permit adequate compliance runs and debugging at builder's plant).
8. Standardization (tools, control systems, etc.).
9. Capability and capacity (including both maximum part size and cycle time).
10. Machine reliability and reputation of vendor for service.

useful literature

A comprehensive 84-page guide to spindles for grinding, milling, boring, ECG, and drilling has dimensional

drawings, application photos, and selection and engineering data. (Setco Industries, Inc.)
Indicate No. 401 on card

"A New High Speed Tool—"Ucon" Indexable Inserts" and "A New Concept in Cutting Tool Materials" are the titles of two papers dealing with the composition, properties, and the performance of Ucon inserts. Ucon is a new high-speed tool for use in applications now served by C-5 through C-7 grades of carbide. (Union Carbide Corp.)
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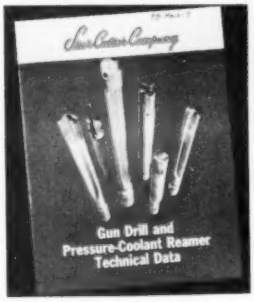

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in a 16-page brochure which includes cost advantages, types, tooth forms, and other information. (StarCut Sales Inc.)
Indicate No. 408 on card

continued on page 67

The Material...
AISI 4340 steel shaft 32, Rockwell C.

The Chip...
Perfect chips formed at 500 sfm, .250 depth of cut, and .020 feed.

The Insert...
SNMP-643, grade K45.

KENNAMETAL®

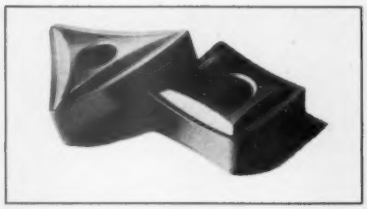
If you're turning, turn to Kennametal

Cost savings and production improvements are inherent in the Kennametal systems approach to tooling.

You'll remove more metal, faster, and work to closer tolerances at less expense using proper tooling.

Inserts

It all starts with Kennametal inserts. From rough turning to finishing, Kennametal has the right insert and grade for the job . . . an insert designed to give you more parts per cutting edge.



They're available in titanium carbide, ceramic, titanium carbide coated or standard grades—in nearly every size, shape and style.

Get the versatility of Kennametal N/P® inserts— cut 5° or 15° positive or 5° negative by simply switching inserts in the same holder. Positive cutting with the same number of edges as negative inserts. A real money saver!

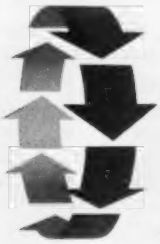
For higher rates of metal removal —without reducing tool life—use our titanium carbide coated KC75™ insert. Its thin coating of titanium carbide, metallurgically bonded to a carbide core, acts to reduce cutting forces and temperatures.

For extremely high speeds and superior surface finishes, Kendex® CO6® ceramic inserts may be appropriate. They work best on rigid machines with well-supported workpieces.

Standardized Tooling Systems

Kenloc® combination holders are a total tooling system.

All Kenloc holders are qualified to ±.003″ to meet the accuracy requirements of N/C machining, yet are priced to compete with unqualified holders.

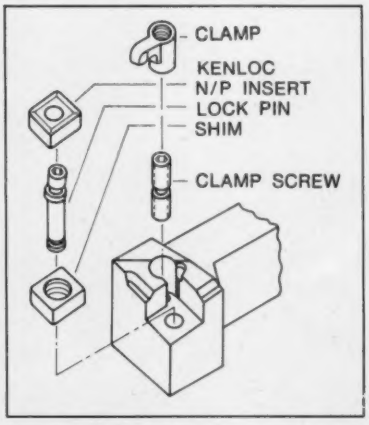


And with Kenloc combination clamping, you can use either top clamp or pin lock type inserts.

You get the best performance, yet it costs you less . . .

- Reduce inventory of tool holders by standardizing.
- Buy fewer types of inserts.
- Reduce hardware inventory. All holders are shipped complete with lock pin, top clamp, clamp screw and shim.
- Save on N/C tooling costs.

Kenloc means qualified tooling at off-the-shelf prices and availability . . . *543* holders in *44* styles.



Kendex tool holders

Economical Kendex tool holders are available in both negative and positive rake angles.

Rigid simplicity of the Kendex top clamp design permits use of utility or precision inserts, with or without chipbreaker plates.

Indexing is fast and accurate, with the cutting edge perfectly aligned against two walls of the full depth pocket.

Get desired chip control with either chipbreaker plate or use of inserts with preformed chip groove.

Sales and Service

Kennametal has over 125 Carbide Engineers—metalcutting specialists —strategically located to give you consistent, personal service. They know that proper tooling is the key to productivity.

Call the one nearest you for help in selecting the tooling system tailored to your needs. He can study your application—even set up tests —to determine the right tooling system and the proper selection of inserts to meet your production needs.

Prompt delivery

For fast delivery of over 6000 standard items, Kennametal maintains a modern, *automated* central distribution center—*plus*, the latest in electronic communications that links its Pittsburgh Distribution Center with 18 field sales offices and eight regional warehouses. This means quicker delivery for you.

So, if you're turning metal, turn to Kennametal for tooling.

Contact your Kennametal carbide engineer. Or, Kennametal Inc., Latrobe, PA 15650. Phone 412-537-3311.

(In Canada contact Kennametal Tools Limited, Hamilton, Ontario.)

We've got it.

KENNAMETAL®

A73-134

INDICATE NO. 216 ON BUSINESS REPLY CARD

Why buy machining systems now--of all times?

Look around you. Maintaining the "status quo" isn't working. Domestic and foreign competition is getting tougher every day.

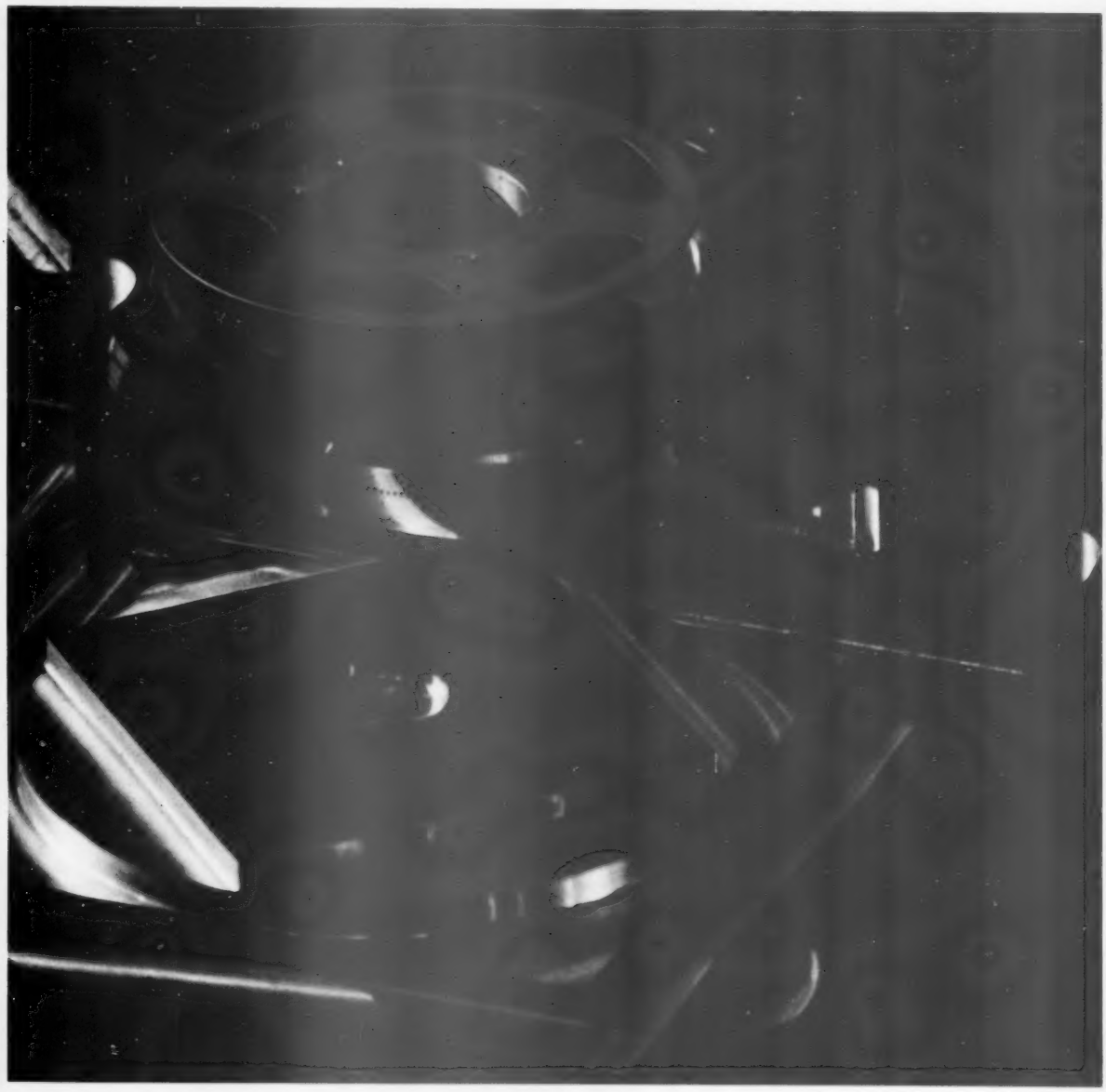
Today's far-sighted firms foresee tomorrow's growing demands. They know they can maintain satisfactory profit levels only if they act now to meet future demands, guard against rising costs, and prepare for the growing challenge of international competition. The forward-looking companies who turn to Ingersoll are planning advanced machining systems with an eye on both present and future needs for increased productivity. They believe in making their own profit opportunities.

So, if you're thinking only of replacing "pockets" of machinery, you're on the right track. But if you want maximum return on your investment, every incremental purchase you make now should relate to your longer range objectives. It's not *how much* you buy, it's *how* you buy.

But this takes professional planning, including the capability to recommend and produce whatever is needed for today's as well as tomorrow's needs. Ingersoll can give you that professional assistance, and deliver manufacturing systems that include the newest technical advances—ranging from numerically-controlled machines and computer monitoring to air supported pallets and time-saving material handling and scheduling techniques. Call today—get Ingersoll involved.

INGERSOLL

The Ingersoll Milling Machine Company. Manufacturing systems throughout the country—and the world. Rockford, Illinois. (815) 987-6000



useful literature

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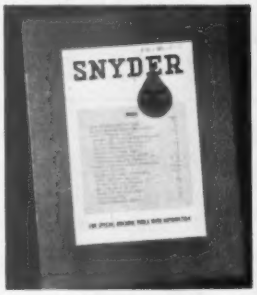
Types of special machine tools and hydraulic system maintenance are included

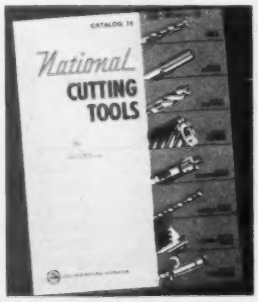


in a 20-page hydraulics and lubrication manual. (Snyder Corp.)
Indicate No. 409 on card

Red Ring products and services for gear manufacturers are described and illustrated in a 27-page brochure. (National Broach & Machine)

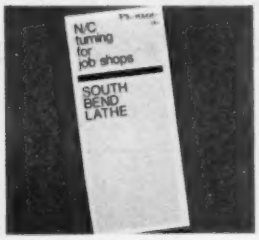
Indicate No. 410 on card

Drills, reamers, end mills, milling cutters, counterbores, carbide tools, miscellaneous tools, and engineering data, are presented in a 74-page catalog. (National Cutting Tools)



Indicate No. 411 on card

A 22-page brochure written for prospective job shop users of NC lathes defines NC terminology, discusses its advantages and disadvantages, and contains an analysis of existing turning methods versus NC. (South Bend Lathe)



Indicate No. 412 on card

Ten models of NC turning machines plus their various standard features and basic components are illustrated and described in 26-page brochure. Includes software systems. (LeBlond, Inc.)

Indicate No. 413 on card

The advantages of chipbreaker drill design for NC as well as general-purpose drilling are described in a 24-page drill guide which includes a drill users comparison chart. (General Chipbreaker Drill Co.)

Indicate No. 414 on card

A metric system drill conversion chart shows decimal equivalents in inches for standard metric sizes. It also shows metric size of number, letter, and fractional drills. (General Chipbreaker Drill Co.)

Indicate No. 415 on card

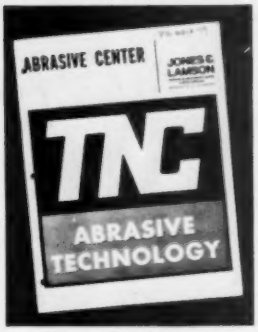
Charts showing suggested cutting speeds when using H.S.S. end mills, feeds and speeds for miniature end mills, decimal and metric equivalents of fractional inches, and a cutter clearance angle chart are offered by Weldon Tool Co.

Indicate No. 416 on card

"Fundamentals of Grinding Technology," a series of 11 instructional data sheets on modern abrasive grinding wheels, is designed to provide a fuller understanding of abrasive cutting tools and of their applications. (Bay State Abrasives)

Indicate No. 417 on card

TNC abrasive technology is described in a 38-page manual which provides the programmer with essential information on the grinding process and a way to use maximum process capability safely. (Jones & Lamson)



Indicate No. 419 on card

A 32-page brochure entitled "Job Applications" shows examples representative of the wide range of production operations presently being performed on Thompson grinders. (Thompson Grinder)

Indicate No. 420 on card

Drilling and machining units and components for multistation metalworking ma-

continued on page 69

HARDINGE

HARDINGE

Super-Precision
Machine Tools & Collets

Super-Precision
PRODUCTION MACHINES

Model AHC
Automatic Chucking Machine

Other Production Machines:

Model HC-AT, High Speed Chucking Machine
Model DSM-A, Second Operation Automatic
Model DSM 59, Second Operation Machine
Model TFB-H, Turning, Facing, Boring
Model HSL, Precision Speed Lathe

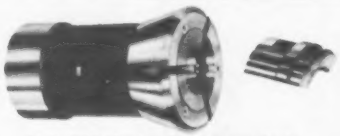
Super-Precision
TOOL ROOM MACHINES

Model HLV-H
Precision Tool Room Lathe

Other Tool Room Machines:

Model DV 59, Precision Lathe
Model UM, Universal Milling Machine

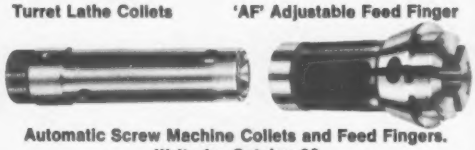
Bulletins on each of the above machines available on request.



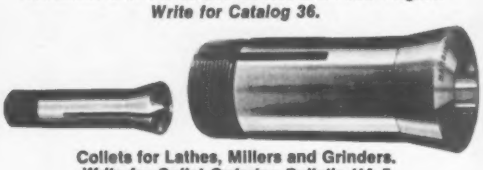
Style "S" Master Collets and Pads

Style "B" Master Feed Fingers and Pads

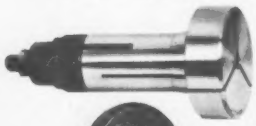
Turret Lathe Collets **'AF' Adjustable Feed Finger**



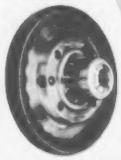
Automatic Screw Machine Collets and Feed Fingers.
Write for Catalog 36.

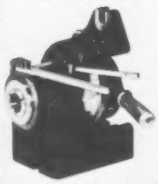


Collets for Lathes, Millers and Grinders.
Write for Collet Ordering Bulletin HA-5.



Dead Length Collet, and Step Chuck





Hardinge Sjogren Speed Collet Chucks **Collet Index Fixtures**
Write for Index Fixture Bulletin CF-10.

Immediate Stock Delivery From:

Boston	617-653-2770	St. Louis	314-432-4115
Chicago	312-685-7242	St. Petersburg	813-896-9183
Dayton	513-222-6572	San Francisco	415-961-5441
Detroit	313-435-0060	Seattle	206-392-6493
Elmira, N.Y.	607-734-2281	Springfield, N.J.	201-376-2530
Hartford	203-666-4641	Mexico City, Mexico	557-13-48
Horseheads, N.Y.	607-734-2281	Stratford, Canada	519-271-6440
Los Angeles	213-261-0103	Marden, South Australia	37 2301
Minneapolis	612-339-8678		
New York	212-925-9677		
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Portland, Ore.	503-232-4404		
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Hardinge Brothers, Inc.
Elmira, N.Y. 14902

HARDINGE

"Performance Has Established Leadership for Hardinge"

useful literature

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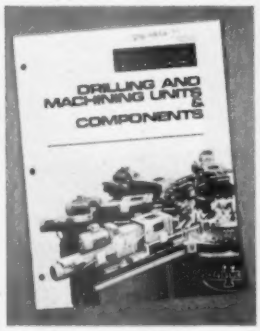
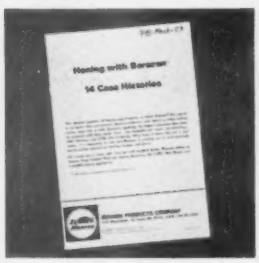


chines are illustrated in a 26-page brochure. Mechanical way-type and air-hydraulic drill units are included as well as many accessories. (Ferguson Machine Co.)
Indicate No. 421 on card

A 24-page brochure includes 21 case histories showing what Sunnen power honing

can do to improve production. (Sunnen Products Co.)
Indicate No. 422 on card

An 8-page booklet contains 14 honing case histories in which Borazon has proved



to be better than conventional abrasive materials. (Sunnen Products Co.)
Indicate No. 423 on card

Why it pays to check your "SMOPS" (stones, mandrels, oil, pressure, speed) is pre-

sented in a 8-page booklet. (Sunnen Products Co.)
Indicate No. 424 on card

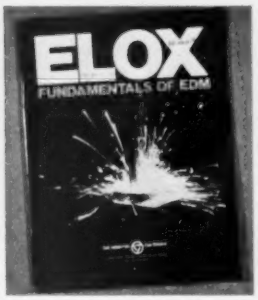
A variety of DeWalt radial arm saws is illustrated and

described in a series of four 4-page brochures. (Black & Decker Mfg. Co.)
Indicate No. 432 on card

A set of five Tech-Tips respectively treats speeds and feeds for spade drills, a chucking face driver, burnishing of air and hydraulic

cylinders, speeds and feeds for Microller burnishing tools, and a chart shows increase in surface hardness through burnishing. (Madison Industries)
Indicate No. 425 on card

The theory and fundamentals of electrical discharge machining are presented in a 36-page brochure. The



machine tool, controls, metal removal rates, surface finish, etc., are included in addition to a glossary of terms. (Elox Division)
Indicate No. 426 on card

A 114-page small size application data booklet is a handy pocket reference to the selection of single-point cemented carbide and ceramic cutting tools. (Carboloy Systems Department)
Indicate No. 427 on card

Recommended feeds and speeds for using single point boring cutters, and grinding information for various types of single point lathe and planer tools, are shown in two charts, respectively. (Armstrong Bros. Tool Co.)
Indicate No. 428 on card

National Acme offers three helpful technical publications: **Acme-Gridley Multiple Spindle Chucking Ma-**

chines. Sixteen pages. *Indicate No. 429 on card.* **Acme-Gridley Multiple Spindle Bar Machines.** Sixteen pages. *Indicate No. 430 on card.* **How Acme-Gridleys Eliminate Costly Handling,** secondary operations. Four pages. *Indicate No. 431 on card.*

A complete line of power tools and accessories are listed and illustrated in a 154-page tool guide. In-

cludes portable vacuum cleaners and grinders. (Black & Decker Mfg. Co.)
Indicate No. 433 on card

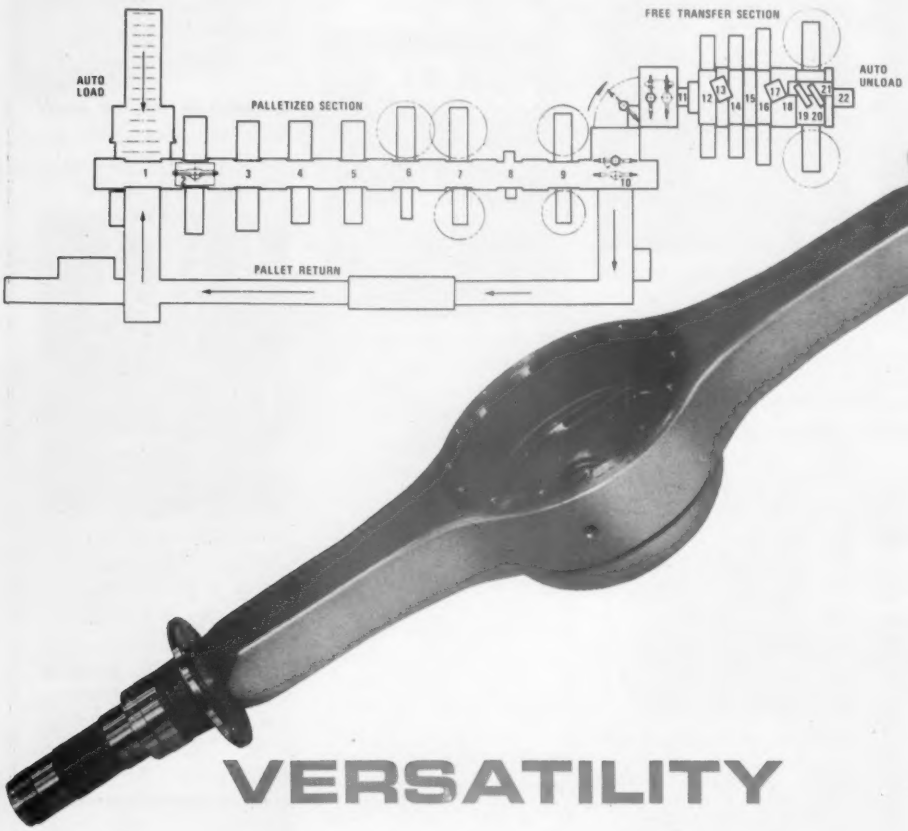
Shelf-stocked grinding wheels for surface grinding, tool and cutter grinding, general-purpose off-hand grinding, etc., are present-

ed in a 16-page format that guides the reader to a proper wheel selection. (Simonds Abrasive Division)
Indicate No. 434 on card

Cutting-off machines and automatic feeders for efficient high-speed cutting-off and forming of tubing, pipe, and bar stock are presented in a 12-page brochure. Included is a hot spinning machine for clos-

continued on page 75

20 DIFFERENT AXLE



VERSATILITY

250-pound rear axles are loaded and unloaded automatically, machined and inspected at a rate of almost one per minute on a combination pallet and free transfer type 22-station machine.

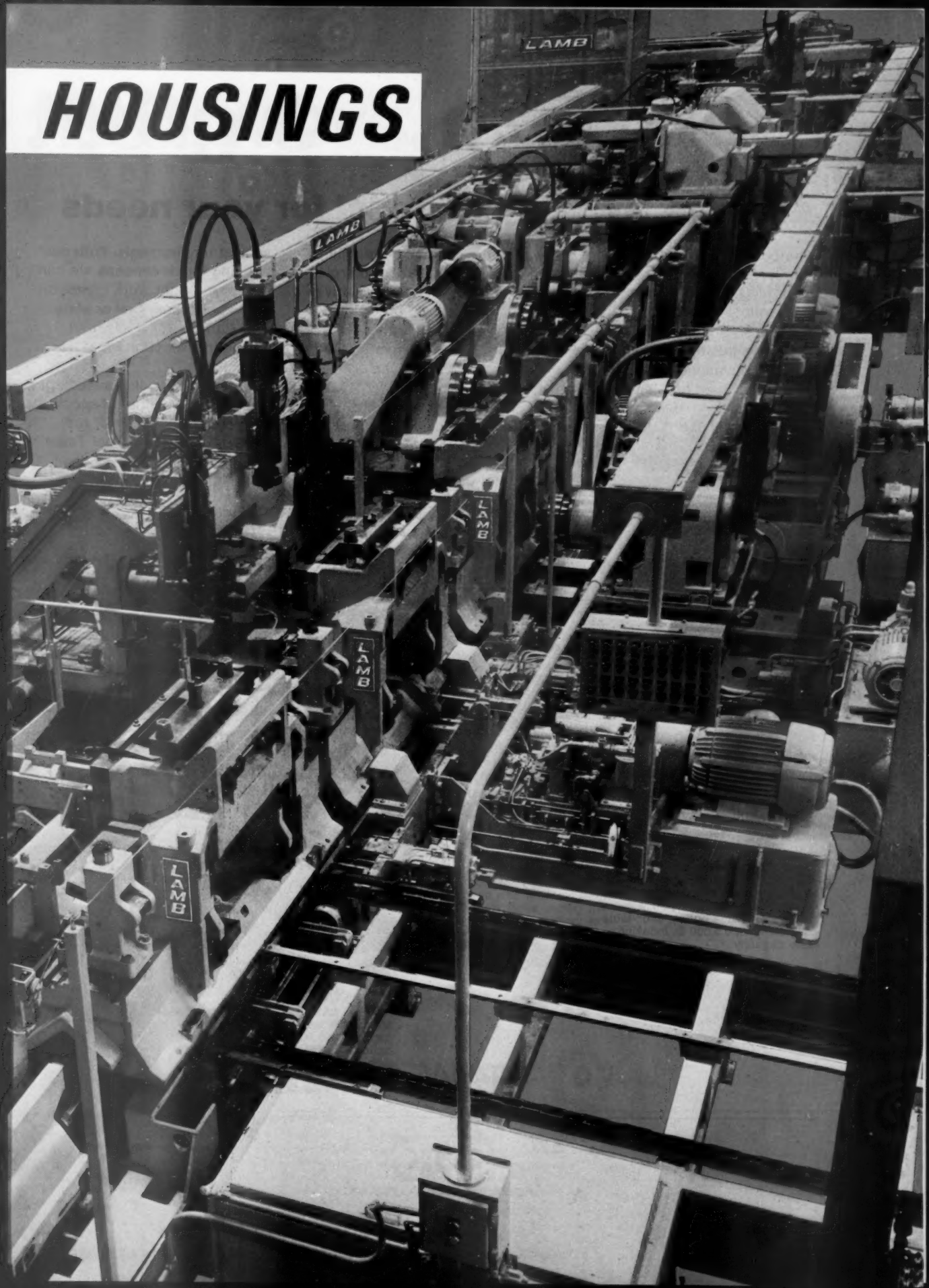
LAMB

F. Jos. ***LAMB*** *Co.*
5663 E. 9 Mile Road, Warren, Mich. 48091
P.O. Box 4611, Detroit, Michigan 48234
(313) 536-3535 Telex 23-0324

Engineers and Builders of
Special Machines and Automation Equipment

INDICATE NO. 219 ON BUSINESS REPLY CARD

HOUSINGS



Now... 3 great

And one is the right model for your needs

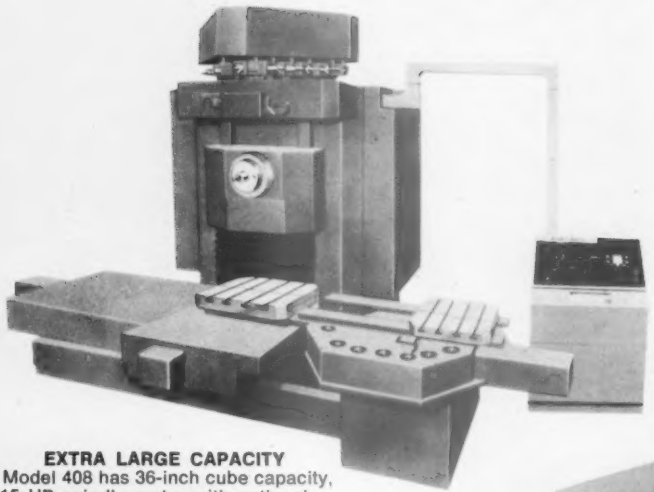
The combination of precision, power, performance and price built into the XLO Parker Model 108 Work Center has made it a winner. So popular that we've expanded this basic concept into a line of advanced work centers offering an even greater range of performance.

Each model in this "08" Series offers the advanced capabilities of the new XLO/NCS Control System, plus direct servo drives on all axes, a rigid precision spindle with automatic positioning, and a new random-select/automatic tool changer with tool libraries of from 24 to 60 tools.

And, if you don't see the model you need in this "08" Series, we'll be happy to discuss your special requirements. With our building block concept, we can design the right work center for your application. Call or write XLO Parker, Box 40, Howell, Michigan. Telephone (517) 546-5330.

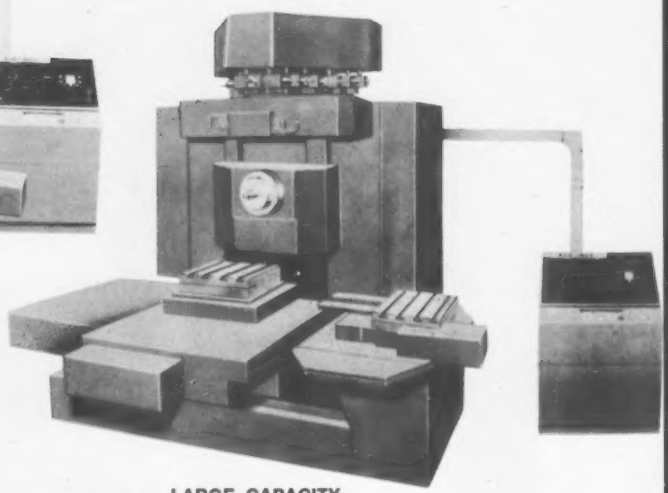
XLO Parker is also a leading designer and builder of *special machines. A member of the EX-Cell-O Machine Tool Team.*

Select the XLO Parker model that best meets your requirements.



EXTRA LARGE CAPACITY
Model 408 has 36-inch cube capacity, 15 HP spindle motor with optional 25 HP motor, 24-tool library with up to 60 tool storage option, 360° table positioning, and 5,000 lb. indexing table capacity.

If you need a work center with greater capacities than the Model 108, check those offered in these "08" models.



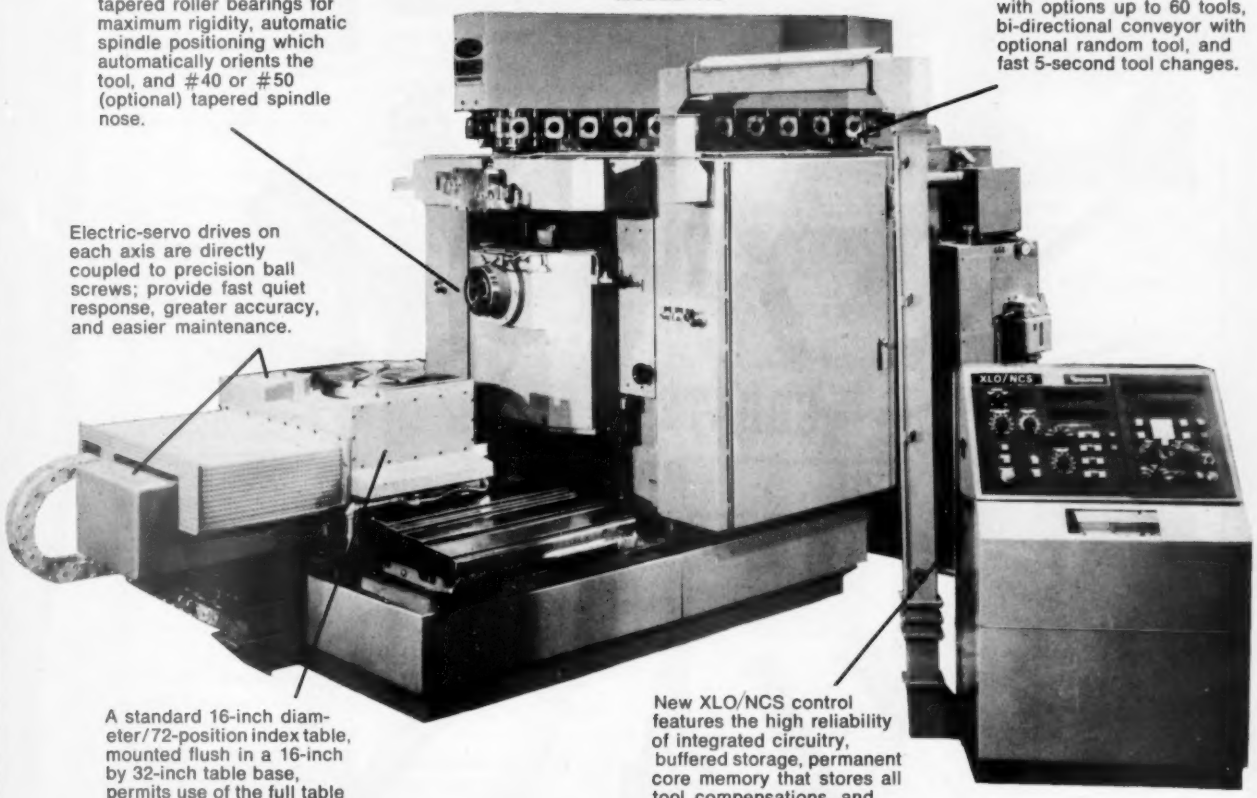
LARGE CAPACITY
Model 208 features 24-inch cube capacity, 15 HP spindle motor with optional 25 HP motor, 24-tool library with up to 60 tool storage option, 360° table positioning, and 2,000 lb. indexing table capacity.

NC work centers

Powerful work spindle features 20-3,000 RPM speed variations, large tapered roller bearings for maximum rigidity, automatic spindle positioning which automatically orients the tool, and #40 or #50 (optional) tapered spindle nose.

Automatic tool changer with random select option, standard 24-tool library with options up to 60 tools, bi-directional conveyor with optional random tool, and fast 5-second tool changes.

MODEL 108



Electric-servo drives on each axis are directly coupled to precision ball screws; provide fast quiet response, greater accuracy, and easier maintenance.

A standard 16-inch diameter/72-position index table, mounted flush in a 16-inch by 32-inch table base, permits use of the full table dimensions for mounting parts and fixtures when indexing is not required.

New XLO/NCS control features the high reliability of integrated circuitry, buffered storage, permanent core memory that stores all tool compensations, and feed rate and spindle speed modifiers that permit program editing. Also speed and feed overrides may be made during the machining operation; full program display capability. Complete program editing available with optional ESP.

XLO PARKER

A UNIT OF

XLO®

EX-CELL-O CORPORATION

INDICATE NO. 220 ON BUSINESS REPLY CARD

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REWARD

true productivity

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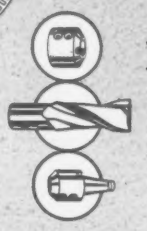


The Weldon
Tool Company
3000 Woodhill Road
Cleveland, Ohio
44104
(216) 721-5454

ASK THE MAN WHO USES WELDON!

Write for catalog No. 12

INDICATE NO. 221 ON BUSINESS REPLY CARD

AA-781

useful literature

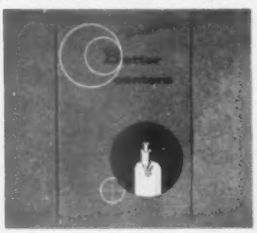
continued from page 69

ing tube ends. (Modern Machine Tool Co.)
Indicate No. 435 on card

Polar Chip ionic coolant which permits higher feeds and speeds and extends

tool life is described in an 8-page bulletin. (Polar Chip, Inc.)
Indicate No. 436 on card

A 10-page booklet called "Better Centers" illustrates and describes errors com-



monly found in center holes of work parts and how to correct them. (Ex-Cell-O Corp.)
Indicate No. 437 on card

Superabrasive products for grinding wheels, saw blades, plated tools, polishing compounds, and diamond tools are described in a 6-page

fold-out brochure. (General Electric Co.)
Indicate No. 438 on card

Borazon cubic boron nitride, its properties, characteristics, and applications, are described in a 12-page brochure. It explains the im-

proved surface integrity, longer tool life, and time saved in both wet and dry operations. (General Electric Co.)
Indicate No. 439 on card

Trueing and dressing of Borazon cubic boron nitride wheels are described in a 20-page pocket-size bro-

chure. Also includes speeds, grinding fluids, and general tips. (General Electric Co.)
Indicate No. 440 on card

A 40-page internal grinding booklet presents a comprehensive digest of current internal grinding practices along with information on wheelheads and wheels. (Heald Machine Division)
Indicate No. 441 on card

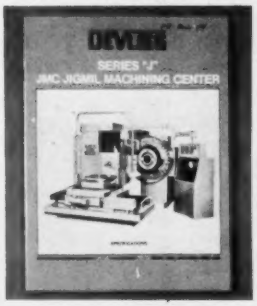
"Fundamentals of Broaching," a 12-page illustrated article, deals with the increasing productivity of to-

day's new broaching machines and tools. (Babcock & Wilcox)
Indicate No. 442 on card

The Series K Spiramatic Jigmil, a range of basic machines for precision boring, milling, and drilling opera-

tions, is described in a 40-page illustrated brochure. (DeVlieg Machine Co.)
Indicate No. 443 on card

The Series J Jigmil and Jigmil Machining Center are described in a 16-page and an 18-page brochure, respectively. Both brochures include construction fea-

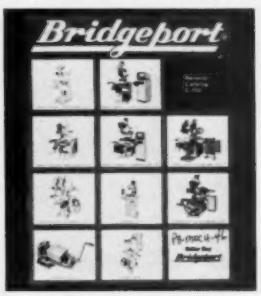


tures and controls. (DeVlieg Machine Co.)
Indicate No. 444 on card

The manually loaded automatic tool changer for Spiramatic Jigmils is described

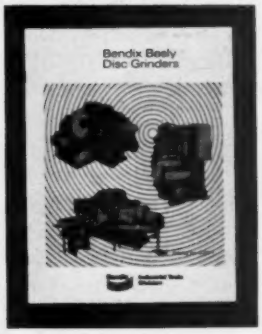
in an 8-page fold-out brochure. (DeVlieg Machine Co.)
Indicate No. 445 on card

Specifications for all Bridgeport machines are listed in a 16-page general catalog. Also included are descrip-



tions, illustrations, and specifications for all heads and accessories. (Bridgeport Machines)
Indicate No. 446 on card

"Bendix Besly Disc Grinders" is a 28-page illustrated



continued on page 77

Five success stories from Hartford

All these small parts are being formed on high speed headers from Hartford Special...at greater speeds and material savings than you could dream of.

But it wasn't always that way!

Not so long ago these parts were being made on a screw machine or grinder. Production was slower, less accurate and more costly. In each case Hartford Special figured out a way to form them on their two blow headers, at closer tolerances, at greater speeds, at a substantial savings in materials and production costs.

We're not saying that every small part can be headed on our high speed machines, but we know a lot of them can be formed in a two blow header. And, Hartford Special is the expert at figuring out how to do it. Give us a call. Or contact your nearest Hartford representative.

We're looking for another success story. Maybe you're it!

Hartford Special Machinery Company, College Highway, Simsbury, Connecticut 06070. Telephone (203) 658-7601.

HARTFORD.

HIGH SPEED HEADERS & THREADERS

INDICATE NO. 222 ON BUSINESS REPLY CARD

useful literature

continued from page 75

brochure describing single- and double-spindle horizontal and vertical machines for grinding surfaces flat and parallel. (Bendix Industrial Tools Division)
Indicate No. 447 on card

"Introduction to Disc Grinding" is the title of a 16-page brochure that covers setup, alignment and feed mech-

anisms as well as describing disc types, bonds and applications. (Bendix Abrasives Division)
Indicate No. 448 on card

Pocket-sized slide selector gives useful information on machining 23 grades of stainless steel; includes speed and feed readings for

each on various types of operations. (Carpenter Technology)
Indicate No. 449 on card

Comparative lab tests and user reports in 16-page booklet offer evidence that Carpenter Project '70 stainless steel bars can provide automatic screw machine shops with production eco-

nomies. (Carpenter Technology)
Indicate No. 450 on card

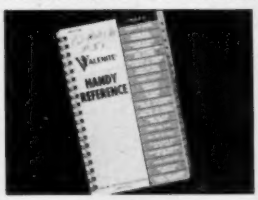
End mill speed and feed selector chart is large wall chart listing recommended

operating parameters for machining most common materials. (DoALL Co.)
Indicate No. 452 on card

Four bulletins offered by Hardinge Brothers describe

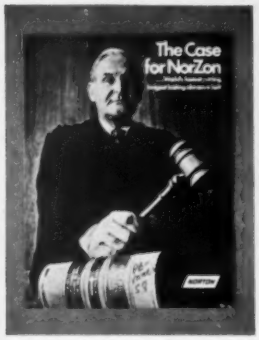
models of precision lathes.
Indicate No. 453 on card.

Pocket-size "Handy Reference" manual contains full information on carbide



grades, selection, feeds and speeds, size and conversion charts, plus many reference tables of practical use to the machinist. (Valenite)
Indicate No. 451 on card

In-plant trial results present the case for Norton's NorZon zirconia alumina



abrasive belts. The evidence is contained in a six-page brochure.
Indicate No. 455 on card

A 12-page applications section in a 20-page brochure covering details of Thomson

Industries' template controlled Mill-Drill table offers 32 ways to use this device.
Indicate No. 456 on card

How the Lapmaster poduces precision flatness and finish for industry is told in Bulle-

tin L439, a 12-page brochure offered by Lapmaster Division.
Indicate No. 457 on card

A 4-page bulletin describes new 3-spindle dual lapping machines for lapping both

sides of part in one continuous operation. (Lapmaster Division, Crane Packing Co.)
Indicate No. 458 on card

Data on its second generation of titanium coated carbide cutting tool inserts is

contained in a brochure offered by Sandvik covering its "Gamma Coated" GC 1025 grade. (Sandvik)
Indicate No. 459 on card

Literature is offered by Hardinge Brothers covering its complete line of 5C

continued on page 79

The Lucas eliminator.

It's a tough, lean machine.

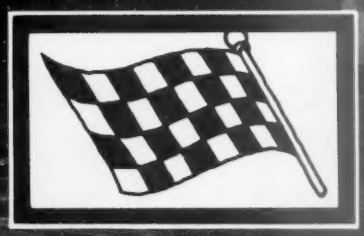
New Lucas horizontal boring mill has a total of 13 gears. This is fewer than our original 1901 model.

And what machines they are!

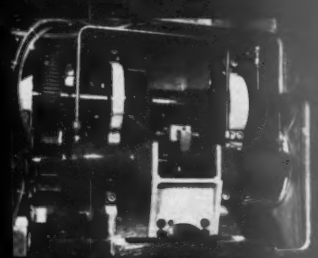
We're the first to put direct-coupled I.C. SCR-controlled feed motors directly to ball screws.

Eliminating the gear box! Manual servo control simulates N/C control and monitoring. The uncomplicated spindle drive simplifies maintenance.

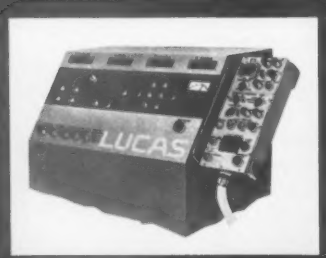
And there's a wide range of options in 30, 40 and 50 h.p. models—table or floor-type. Write for our colorful brochure. Our address: 12302 Kirby Ave., Cleveland, Ohio 44108.



Litton LUCAS MACHINE DIVISION



Only 10 gears in this spindle head! And noise level is below 80 dB A in most speed ranges.



Manual controller also permits single-point threading, infinitely variable slope-cutting, and inch-metric switchable readout.

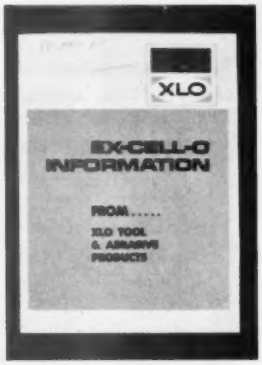
Solid-state SCR drives permit faster positioning, eliminate gear boxes and motor-generator sets or hydraulic units.

useful literature

continued from page 77

spindle tooling; collets for automatic screw machines and for lathes, milling machines and grinders; carbide cutting and threading tools.
Indicate No. 454 on card

An in-depth information kit on titanium carbide that includes technical information on what it is, how it



functions, and its applications. Included are metal cutting test results and charts comparing titanium carbide with tungsten carbides. (Ex-Cell-O Corp.)
Indicate No. 460 on card

Catalog's eight pages feature the advantages of crushform grinding and various machines available to

perform the process. (Bendix Automation & Measurement Division)
Indicate No. 462 on card

End mills and die sinking cutters are the subjects of a 28-page catalog that also includes charts, graphs, and other application informa-

continued

Whenever you TURN-TURN to H.E.S.

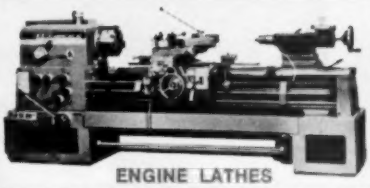
Offering an up-to-the-minute lathe to match your turning needs . . . whenever and whatever they are. From basic engine lathes for toolroom work to sophisticated N/C machines for production runs, H.E.S. has the lathe you need to best suit your needs.

H.E.S. MACHINE TOOL maintains a large inventory of conventional machines for speedier delivery.

H.E.S. ENGINEERING can offer tooling up specifications and provide machine modifications to suit your special turning requirements.

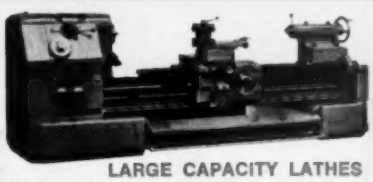
H.E.S. FINANCE has been established for the sole purpose of assisting in the sale of our products. Terms are arranged on an individual case basis.

We make it easier to obtain what will be **THE PRIDE OF YOUR TURNING DEPARTMENT**



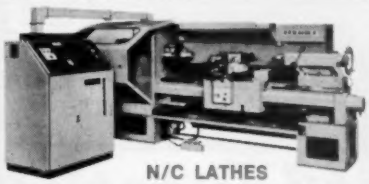
ENGINE LATHES

H.E.S. 16, 20, 24. For toolroom or production. Available with tracer unit, automatic cycling, two direction rapid traverse and hydraulic power chuck.



LARGE CAPACITY LATHES

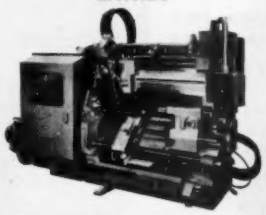
Jupiter 830, Jupiter 920. When the extreme in power and capacity is required. Each is available with straight or gap bed and with center distances of 5 feet to 20 feet. Can be equipped with a tracer unit. Suitable for Production. Toolroom or Maintenance turning.



N/C LATHES

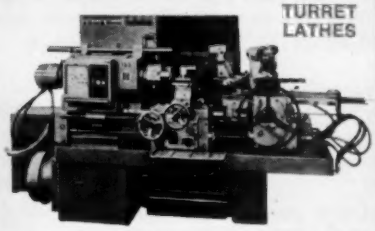
14 NCS, 24 NCS, 24 NCSA, 24 NCA. Covering a broad range of numerical control turning equipment that stresses simplicity of tooling and programming. Semi-automatic operation with manual speed and tool changing to sophisticated fully automatic models — all capable of chucking and between center work.

AUTOMATIC TRACER LATHES



MS-1, Transpilote, S-Pilote, V-Pilote. A wide selection of maximum performance automatic copying lathes with fast set-up and programming controls. Slide combinations, most featuring copying capability, provide a proven building block answer to turning problems.

TURRET LATHES



TS-3, TS-5. High performance turret lathes with fully automatic headstocks that offer speed changes by programmed peg board control. interference free hydraulic copying attachments for additional utility.

H.E.S. MACHINE TOOL, INC.

Main Office: 30 Henry Street, Teterboro, N.J. 07608 • 201/288-9523
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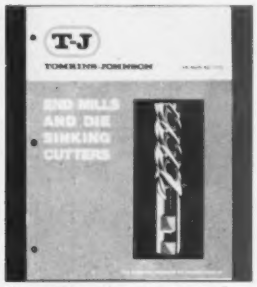
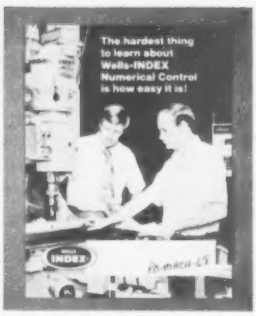


tion. (Tomkins-Johnson Co.)
Indicate No. 464 on card

A report on the effectiveness of Carbond C-24 graphitic bonded diamond wheels as compared with resinoid bonded diamond wheels is offered by Ex-Cell-O's Tool & Abrasive Products unit. The report includes wheel data and test parameters as well as test results.
Indicate No. 461 on card

A technical paper entitled "Flexible Manufacturing Systems—a Solution for the Mid-volume, Mid-variety Parts Manufacturer" and authored by Paul R. Haas is available from Kearney & Trecker Corp.
Indicate No. 463 on card

Information concerning the advantages of using its new Mark Century Wells-Index numerical control package over manual machines and detailed specifications for the 2-hp, 3-axis contouring



machine are contained in a 4-page brochure offered by Wells-Index Corp.
Indicate No. 465 on card

Typical applications of its carbide tools, particularly form tools, on automatic

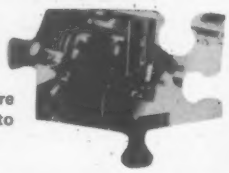
screw machines are described in a data sheet offered by Acco, Crafts Division.
Indicate No. 466 on card

An "Areas of Circles" chart is offered by Acco for use in computing life ratios of abrasive cutting wheels.

Chart shows wheel areas for diameters to 48 in. by 32nds. (Acco, Allison-Campbell Division)
Indicate No. 467 on card

General information and engineering advice in the application of chucking tools constitutes a large part of the 32-page catalog offered by Rohm Tool Co. Coverage

Are cut-off problems puzzling you??



This missing piece could be the answer to your problem. Here is where standard slides and tooling shown can be engineered to your specific job.

If you are cutting-off tubing, pipe or bars, you can also plunge, turn, groove, form, face and chamfer while cutting off -- thus eliminating secondary operations on many jobs.

MODERN MACHINE TOOL COMPANY has been helping solve problems puzzling industry for more than 50 years. We may not have all the answers, but we certainly try. Our lathe-type machines and automatic feeders perform fast and efficiently.

MODERN capacities range from ¼" to 8" in diameter and automatic feeders provide storage for up to 5 tons of 20 foot length stock.

For complete information, write for our brochure today.

MODERN MACHINE TOOL COMPANY
2005 Losey Ave.
Jackson, Michigan 49203
(517) 784-7134

141

INDICATE NO. 225 ON BUSINESS REPLY CARD

includes lathe chucks, live centers, face drivers, machine vises, and drill chucks.
Indicate No. 468 on card

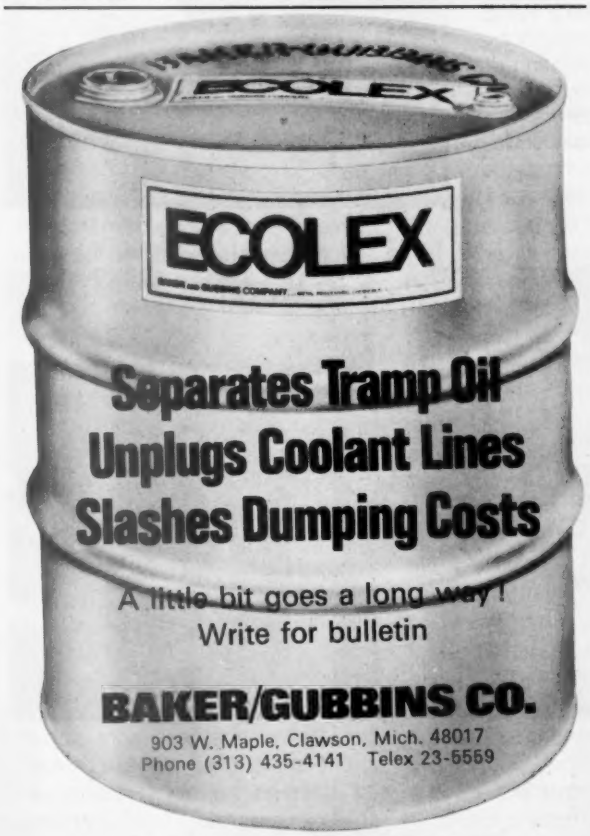
Educational material used in teaching its technical sales people in the features of its Series ACM NC contour milling machines is made available to PLANBOOK readers by New England Machine & Tool Co.
Indicate No. 469 on card

Abrasive cut-off machines and wheels produced by Everett Industries are covered in its 16-p. general catalog.
Indicate No. 470 on card

Multiple-spindle vertical turning, boring, and grinding machines in stationary types, rotating types, and indexing types are described in an 8-p. bulletin. *Indicate No. 471 on card.* **Wickes' well-known line of crankshaft lathes** is comprehensively covered in another brochure. *Indicate No. 472 on card.* (Wickes Corp)

Hand- and power-operated toggle clamps with complete specifications are featured in a 40-p. catalog. *Indicate No. 473 on card.* **Air-and hydraulic-powered workholding components** are described in a 12-p. booklet. *Indicate No. 474 on card.* (De-Sta-Co Division, Dover Corp.)

Three models of NC machining centers and three-axis drilling machines with Hydra-Point control are comprehensively described in a 16-p. booklet. (Moog Inc.)
Indicate No. 475 on card



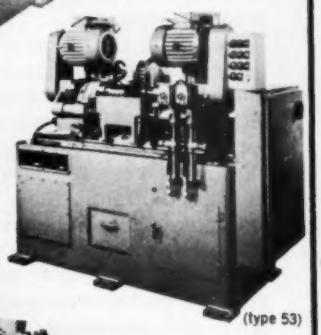
INDICATE NO. 226 ON BUSINESS REPLY CARD

a million shapes at your fingertips

(type 46)

automatic pointing machines

single & double end finishing machines



(type 53)

(type 431)

automatic chucking & shaving machines

Now, the three basic Economy designed secondary operation machines are complimented by additional models sized for your job requirements. Ruggedly constructed, Economy machines will meet your exact requirements for individual operations or to function as an integral part of your production system. Fully automatic, they perform smoothly to finish parts well into thousands per hour. Our sales and engineering service will help you select the best machine and multiple optional tooling to meet your requirements. Comprehensive brochures will provide you with more complete information and specifications.

ECONOMY
MACHINE TOOL CORPORATION
3985 Ben Hur Ave., Willoughby, Ohio · Telephone: 216-942-1620

INDICATE NO. 227 ON BUSINESS REPLY CARD

The Ingersoll-Rand Approach to Assembly Productivity

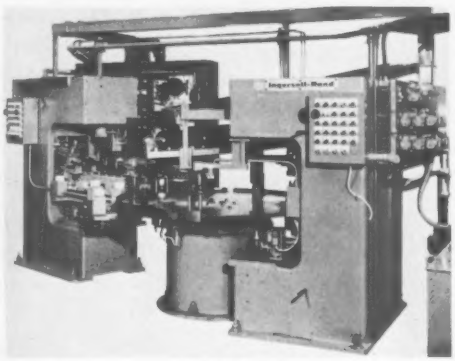
ASSEMBLY CAPABILITY AT INGERSOLL-RAND: APPROACH TO ASSEMBLY PRODUCTIVITY—IT COMES IN ALL SHAPES, SIZES AND TYPES.

BY: J. McPhail, Sales Manager, Automatic Production Systems
R. Sponsler, Marketing Manager, Industrial Tools

With the rapid growth of productivity-enhancing automatic assembly in the U.S. and abroad, Ingersoll-Rand starts this new year with proven assembly systems of every major type—synchronous and nonsynchronous transfer lines, as well as indexing and continuous-motion rotary table machines.

In the Ingersoll-Rand nonsynchronous transfer system shown below (Photo #1) 155 mm artillery shells are safely and efficiently assembled in an arsenal operated by a contractor on behalf of the U.S. Army.

This unit (Photo #2) contains a rotary table machine to assemble water pumps at the largest and newest automotive engine plant in the world—the Ford Pinto plant at Lima, Ohio. In addition to this machine, Ingersoll-Rand designed, built and installed 32 machines to feed, assemble and inspect critical fasteners in the engine's final assembly operation.



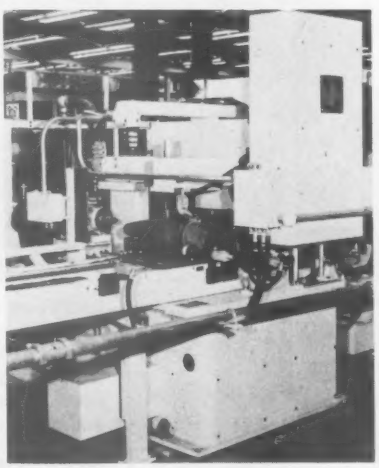
#2

Two other Ford-Lima units are shown here (Photo #3), undergoing final inspection at APS. In addition to electronic torque assurance (TAS) on all torquing operations, this line contains the two latest innovations for assurance of proper installation torque coupled with 100% inspection for variables which adversely affect joint clamping force. These two new techniques developed by Ingersoll-Rand are called "Torque-Time" and "Torque-Turn." These innovations incorporate the measurement of elapsed time or angular rotation of the fastener from a given threshold torque and comparison of these readings to establish quality limits. This provides manufacturers with the highest level of fastener quality assurance obtainable today under production conditions.

#3

Still another innovation by I-R at Ford-Lima is the sophisticated parts-qualifying and hopper-feeding systems. These systems have three parts—prequalifying bowl to reject the largest percentage of faulty parts—accumulating in-line storage hopper—final orienting and feeder bowl—to assure minimum downtime and optimum reliability of the parts being fed.

This close-up view (Photo #4) shows a bearing-pressing operation at Buick Motor Division's Gear and Axle Plant where I-R's Automatic Production Systems Group had full responsibility for a 45-station, 350-ft.-long differential assembly system. Whether it's a single hand-held unit or a total assembly system, Ingersoll-Rand Automatic Production Systems has the expertise to provide equipment to exact specifications to help solve your assembly problems.



#1

#4

Assembly Problems Push Search for Solutions

"Even when we specify standard fasteners, we still find too much variation from one vendor to another."

"Too often, assembly machine makers seem to want us to adapt our problem to their machines."

"Our continuing search is for a more accurate welding pulse generator."

"We need to speed up our soldering operations, but we're still limited by material preparation."

Those comments reflect the tone of a large number of manufacturers contacted by the PLANBOOK's editors. First, all of them perform some type of assembly, although the range of types is vast. Second, each has some problem or set of problems he'd like to solve: They range from a simple shortage of fasteners to the need to completely automate today's manual operation. And third, almost to a man they feel a need for a closer working relationship between their suppliers and themselves.

As one manufacturing engineer put it: "We used to keep our product development work under wraps. Then, when we were ready, we'd call in the equipment builders and other suppliers. Now, we're trying to get them in at the product inception. Under the old system, we'd learn we had tied ourselves to nonstandard, and costly manufacturing solutions."

MECHANICAL FASTENERS

"There is some talk about the quality of fasteners being shipped today, but I'd rather talk about the much more pressing problems of supply. The fastener industry seems to have gone from a disaster business into one of great shortages and great demand in a period of a year and a half. We could buy some types of fasteners, like rivets, from an on-hand inventory. Now, we are getting quoted three and four months. And these are standard fasteners." That's the plight at the Metal Products Group, Bliss & Laughlin Industries, according to J. W. Rose, group vice president.

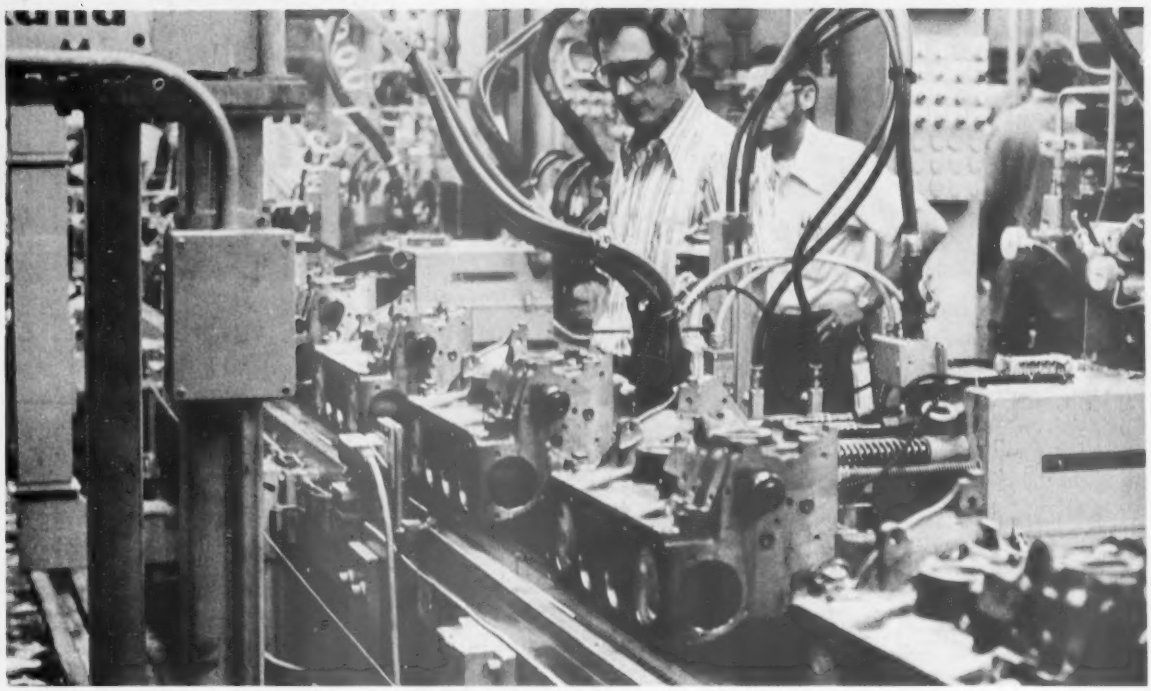
In a time when everything is short, it should come as no surprise, perhaps. But most manufacturers agree. Carl Insel, director of manufacturing, Communications Division, Motorola, Inc., says: "It's almost unbelievable, but we're now out to something like a 38-week wait on standard lock washer screws."

Two other problems have been brought out by fastener users. One is explained this way by Larry Levine, manager of manufacturing engineering, Hotpoint Co., division of General Electric Co.: "You can buy the so-called standards from a variety of sources, and then find you have great differences in performance from one vendor to another. These are very subtle differences, supposedly both according to specs, but one meets the high side and the other the low side, and sometimes you have a disaster in your shop because you just got a shipment from a different vendor. Maybe we just have to get smarter on how we specify fasteners. With today's delivery problems, pre-inspecting every load isn't necessarily the answer, because you might want to reject a load but can't because there isn't a back-up load on hand."

In addition to this problem, several users mentioned that hydrogen embrittlement is a problem. James McCarthy, manager of manufacturing, Thor Power Tool Co., explains: "If you put a lot of fasteners in automated and semi-automated assembly equipment and then find you have a hydrogen embrittlement problem, just a few screws can create a lot of difficulties."

L. Paul Williams, manager, manufacturing, Controls Division, Eaton Corp., reports some of the same problems: "I think definitely there is a change in quality level, and I'll be darned if I know why. But we have changed sources because of embrittlement on electroplated fasteners."

"Hydrogen embrittlement of fasteners often results from the action of surface cleaning and electroplating processes," explains Stanley S. Knight, metallurgical engineer, Continental Screw Co., New Bedford, Mass. "It manifests itself by self-breakage of some fasteners in a few minutes, hours, or days after assembly. This embarrassing hazard may be enhanced by the metallurgy and heat treatment of the fastener. Thermal baking treatment must be applied to those items subject to this type of treatment. Furthermore, such relief treatments must



Automatic assembly is used extensively on Ford's 2.3 liter engine at the Lima, O., plant. Three major innovations in automatic assembly are a highly sophisticated torquing system for measuring the degrees of turn on bolts, a track-fed oil filter station where the oil filter is automatically attached, and vacuum holding of the oil pan until the block reaches the 22-station bolt-driving station

be monitored by stress-time testing of a significant number of samples from the process lots to assure continuous elimination of the absorbed hydrogen agent."

Most users agree the embrittlement problem is not common, but it's a tough one when they get it. Check your suppliers' processing if it occurs.

WELDING

The most common problem in welding today seems to be one of the environment. A number of users are working with guns that exhaust the smoke at the weld point; some like them, and some do not. Others are looking for better exhaust methods. And with the energy crunch, they're interested in exhausting the smoke but not the in-plant heat.

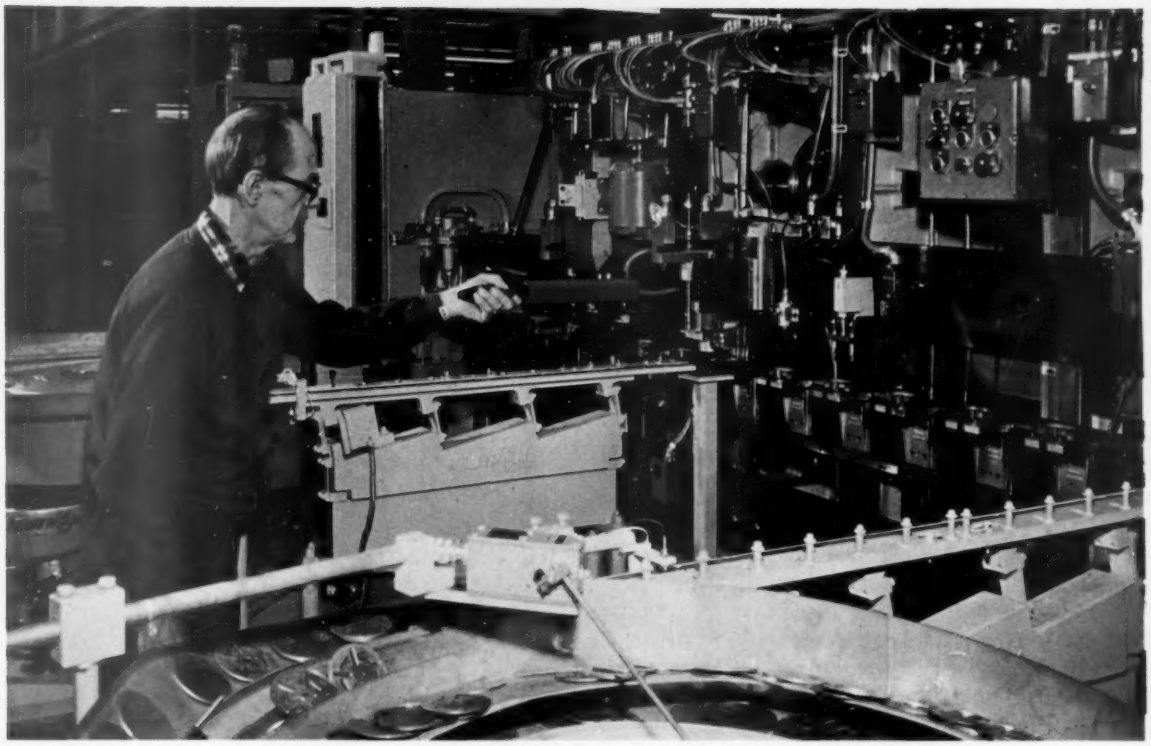
No one interviewed questions the concept of removing the smoke at the source. The single doubt or complaint is that the guns and hoses leading to the guns are more cumbersome for the operator to work with. Robert H. Yanker, manager of Barber-Greene Co.'s Aurora, Ill., plant, says: "When we made the switch from stick to MIG welding, we reduced some of the environment problems. Later, we did try the 'smokeless' guns, but we did not get operator acceptance, so we backed away from them."

Although others have expressed the same concern, not all have had the problem. Julius Vetter, president, Louis Allis Co., says his company is using the guns. Henry M. Knauth, general works manager, Falk Corp., division of Sundstrand Corp., says: "We have not used the guns in production yet. But the weld shop has been trying them out, and I think we'll get to them. It's just a matter of time."

And Charles Eberhardt, manufacturing manager, Aurora (Ill.) Plant, Caterpillar Tractor Co., says: "We are deeply involved right now in putting the smoke-extractor guns on all of our welding equipment. Not all operators like it. It is a little heavier and a little different. But all new welders are using them in our training school, so it's all they know. In addition, I think we'll see the size and the weight of guns come down, so there will be less resistance on the part of the experienced hands."

The first company on the market with the "smokeless gun" was Hobart Brothers Co., Troy, O. Larry Henry, development engineer, says: "Generally, we have found operator acceptance for the new guns to be good, or even excellent. In some cases, there is a reluctance to change, but we encounter that same reluctance to any change with some operators.

"We are aware of instances in which the wrong guns were tried —a lighter gun would have been the one for the job, but for one reason or another, the operator was asked to test what was on hand. The weight difference on a



The yellow "box" in the background is part of a European-developed light curtain that creates an invisible guard across the entire side of this Bodine assembly machine. Frank Riley, vice president, Bodine Corp., says that if the receiver does not get a reflected signal the machine is shut down, creating a fail-safe condition. Further, if the curtain is broken (the man in the photo is using an arm-sized probe to test) at any place in the line, the machine stops. The curtain could replace plastic or metal guards, with their attendant inconvenience

400-amp gun, for example, is only 6 oz in our own line. And, of course, the operator who is concerned with the environment can handle that with no trouble. Mismatching of the gun to the job is rather common in welding. In addition to all of that, we know the problem, we are marketing a lighter (less wear-resistant) cable, and continue to refine the guns. But if an operator has been working with a 250-amp gun and is asked to test a 400-amp smoke exhaust gun, he will not like his comparison."

As to welding environment, Clifford Hubbard, a sales manager for Thermatool Corp., New Rochelle, N.Y., says: "Environmental considerations are among those being considered by some companies who are thinking of switching from arc welding to high-frequency resistance welding. The smoke, the weld spatter, and any other undesirable weld environment problem are gone. Furthermore, since the process can easily be automated, operator safety is better, and we require less power. We have sold two machines to an automobile company to make wheel rims. On that job, we require only one-third the electrical power and also give them a material saving. The environmental and safety considerations were real factors in those installations."

Charles Eberhardt
Caterpillar Tractor Co.

Caterpillar's Eberhardt also has another search on. "We are looking for automatic welders of a special type. In our operation we have fit-up problems, the gap varies, the depth and the deposition varies; we would like to get a tape-controlled machine that would detect the variations, so we can speed up or slow down to get even deposition and a good weld throughout. It looks promising. We are working with some people on it; we want a turnkey operation in which we tell the vendor 'we want the piece to start here and come out finished here, with a quality weld.' "

Clifford Katz, vice president, Interactive Systems Inc., Ann Arbor, Mich., tells PLANBOOK editors: "We have been working on a program to develop a control system to allow for variations in fit-up. We have proved that it can be done; we are looking at a number of parameters simultaneously, and we now are trying to narrow it

down to the fewest number of parameters that must be controlled to do the job.

"Basically, we are using noncontact sensors to detect the weld gap, and then use that signal to control the proper variables so the weld joint is good, and is uniform for the full length. The variables include, of course, traverse rate, wire feed, current, etc. A small computer will be used to translate the sensor signal into process adjustments."

On the control theme, Ron Gallagher, vice president and plant manager, Sturdi-Bilt Materials Handling Division, UNARCO Industries Inc., says: "We are using inert gas shielded welding. Our upright storage frames have gotten so tall, up to 40 ft in one piece and up to 8 ft wide, that a man can't handle them. Just getting the basic welding fixture to work was an accomplishment. But we still haven't accomplished our set-up goal. Operating off pulse generators, where we set in the next size and push the change button, we have found that our pulse generators are not accurate enough to control the nine functions and to serve as measuring devices. Certainly, we would welcome knowledge of a more precise generator for our purposes."

Walter Sauthoff, manager, plant equipment engineering, Automotive Division, A. O. Smith Corp., speaks for those who cited better ventilation in the welding areas: "We are surveying our complete plant, which has thousands of individual welding operations, to make certain we are ventilating properly—not too many fumes under the hood, enough air moving out of the path of that zone, and so forth. We are taking the ventilation route now, rather than changing equipment.

"One control we have, of course, is the condition of the product itself. How clean is it? How much oil is on it? With clean parts we can reduce smoke considerably. But we have another desire in ventilation, and that is to recover the expensive, warm air that we are exhausting along with the weld smoke particulate. We have tried a variety of devices, including electronic precipitators, but we still are not satisfied with our ability to recover good, clean, warm air which we have paid dearly to heat."

Welding at the Mentor, O., plant of Towmotor Corp. is being done with guns that have a smoke exhaust and filter system, with the intake at the tip of the gun. Made by Hobart Brothers Co., Troy, O., the guns are getting between 80 and 100 per cent of the weld smoke before it even gets as high as the operator's hood

AUTOMATIC ASSEMBLY

"In our effort to reduce the manhours put into our products, we find the most promising area is in assembly. For the first time, we are being forced into automatic assembly. Until now, manual assembly was more economical. But it has reached the point at which assembly machines will now pay for themselves," says W. J. Shane, director of manufacturing, West Bend Co.

Ron Gallagher
Sturdi-Bilt Division

"Most of our assembly labor goes into small electrical appliances which have a great variety of components. I think that, at least at first, we will be trying to automate subassemblies, rather than the final product. We will call in manufacturers of assembly equipment, and have already done so, and get their solutions to our problems."

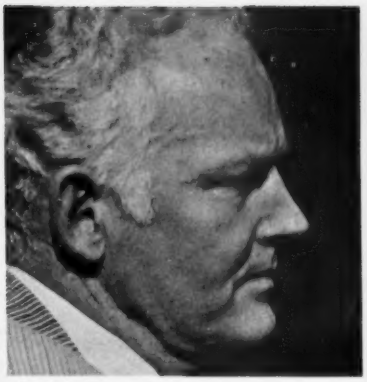
Robert Sparkes, assistant vice president, manufacturing, Victor Comptometer Co., also sees his industry trending toward more automatic assembly. "When our product was electrical and mechanical calculators, we did both

manufacturing and assembly operations largely by hand. Now that we are in the electronics business, we buy more parts and find ourselves increasingly in the assembly business. Our major problem now is lead time. We are going to automatic assembly, but the 10-month to one-year lead time is costly for us."

Patrick Brogan, plant superintendent, Imperial-Eastman Corp., a subsidiary of ITE, agrees with the trend to automated assembly. "We think the progressive assembly line, where one operator does one job and then passes the part on to the next, is out. We are looking toward assembly machines on which a person will complete an assembly or subassembly. We may be talking about a single machine, or about multiple machines (as many as 12) tied together by conveying equipment."

"That is a perfectly logical approach to many assembly problems," comments Robert J. Seccombe, manager, Automatic Production Systems, Ingersoll-Rand, Farmington, Mich. "Where the man must perform some operations, full automation is impractical. Even the most automatic machines we have shipped had some direct labor operations. But the job can be done with a series of index machines, or it can be done in-line with the nonsynchronous machines." (See PRODUCTION, November 1972, page 96.)

The nonsynchronous assembly has been publicized mostly because of its application to the automotive industry by companies including Cross Co., F. Jos. Lamb, and I-R. But Seccombe says it can and should be applied to many other jobs. "It is particularly applicable on those assembly jobs where some automation is justified, with some portions remaining manual . . . and where the manual jobs may vary in time. For example, it might take 8 seconds to do a job on one part and then 15 on the next. The nonsynchronous line gives you that flexibility."



W. J. Shane
West Bend Co.

A substantial portion of the automatic assembly machine business in this country is now captive—plants are designing and building (or having built) their own systems or equipment, some very simple and some thoroughly complex and sophisticated. McCarthy (Thor) explains: "We went outside a little and tried to get some help, but we found, first of all, the expense was considerable, and then we kept running into canned programs that we didn't feel were totally adaptable because of the variety in our lot sizes, which may run from 50 pieces up to several thousand. As a result, we are brainstorming within the company and plan to pretty well nail down our assembly techniques. We're trying to incorporate, for example, some operations that used to be remote subassemblies into the line so we can sustain a continuous flow."

"Assembly equipment makers do have a problem now," admits Gerald Merola, general manager, Systems Division (Troy, Mich.), Chicago Pneumatic Tool Co. "We are anxious to be called in on assembly problems, and we can make a quick estimate of what a solution might cost. At that point, though, we need an agreement with the customer. If he wants an engineering proposal and is willing to pay for it, we'd be glad to work on it . . . and so would most of our competitors. Otherwise, we would appreciate some kind of assurance that the program will be implemented and equipment bought, whether it's ours or a competitor's.

James McCarthy
Thor Power Tool Co.

"With our current backlog and order rates, we must commit our manhours to those 'buy' situations in which we feel confident the project will go, or in which the record of the company assures us that he is not just looking around. That is one of the drawbacks to the 'seller's market,' and it concerns us just as it concerns our customers and prospects. However, assembly machine makers will make any adaptions needed to solve a user's problem . . . if, in fact, automatic assembly is right for the job in the first place."

Brogan (ITE) also says that his division is buying components, such as vibratory bowls, but that the assembly equipment itself is being engineered and built in-house. Huber (Admiral) also says: "We build television sets and our assembly problems must be like those of other companies who do. But our facilities impose some limitations, and for that reason we feel some of our assembly equipment must be tailored to our needs. We do the engineering and building mostly in our own plant and with our own people."

Robert N. Lindner, manager, manufacturing services, Borg-Warner Corp., says he feels one reason for so much in-house building is the relatively short product life cycles on some assemblies. "We must find ways to get flexibility into the operations

continued on page 89

NEW!

Trouble shooter for every assembly operation

Just snap in slugs of hot melt, pull the trigger, and you start saving money.

It's a Nordson AD-25 Hot Melt Applicator made to exterminate production bugs and shoot down high-flying assembly costs 30% to 50%. Hot melts eliminate costly time and space needed for solvent type adhesives to set, often replace staples, clips, rivets, screws, tacks, tape, nails and other costly mechanical fasteners.

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The AD-25 is a sturdy production tool that makes high-strength bonds as fast as you can squeeze the trigger. Connect it wherever there's electricity and compressed air. Hot melt adhesives are available in slug form to bond virtually any material to any material — wood, plastics, ceramics, metal, paper.

The AD-25 takes full advantage of the many economic and performance benefits of hot melts. Hot melts are 100% solids; they are made fluid by heat, and they set instantly as they cool. With no solvents, anti-pollution or ventilation measures are unnecessary. Because hot melts do the joining job invisibly, you can design products without exposed fasteners such as screw heads and rivets.

If you're having product assembly problems, call on Nordson. See a demonstration of our new trouble shooter, the AD-25.

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Ten Vital Fastener Considerations

The following are considered important steps to be taken by users of mechanical fasteners. The suggestions are made by suppliers who have witnessed both successes and tragic failures in selection and application of fasteners. As a user, you might make certain your company covers itself on these points:

1. Consider the fastening method early and get vendor suggestions. A slight change in design could cut assembly costs significantly . . . early notice permits a vendor to tool up if fastener is a special, and to run tests if requirements are nonstandard.

2. Don't use over-engineered fasteners. It's tempting to design something special, maybe something that will do more than you really need. Check your vendors; if a standard will work, use one. On rivets, for example, the most common shank diameter is ⅛ in. If you can use it, you'll benefit in cost, delivery, and availability.

3. Don't use under-engineered fasteners. This usually results from one or both of two motivations: Using one you already stock; buying the low-cost fasteners. Both motives are right only if the fastener will work.

4. Don't fail to consider the total cost of both buying and using the fastener. Cheap fasteners could spell disaster in production if heat treating, machining or forming, cleaning, or other operations at the fastener-maker's plant have been shortcut to hold price down.

5. Consider the full function and total environment for the fastener. Beware of galvanic action; cadmium plated fasteners should use a lower torque than zinc plated ones; don't use electroplated fasteners for "shine," it is for solderability or electrical conductivity . . . runs risk of hydrogen embrittlement.

6. If torque is important, make certain equipment is capable of providing it within the proper limits, and make certain fastener material and geometry will maintain it. For high torques, a special head may be required to avoid rounding corners.

7. Check the materials being specified. The wrong carbon grade or the wrong hardness can turn up in product problems.

8. If you change design of the product, recheck the fastener. Even just a change in material thickness may require a different fastener.

9. If automatic assembly is used, get a fastener that is compatible with it. Consider fastener reliability at the same time you're considering machine speed. If a rivet is to be fed automatically, for example, a length-shaft diameter ratio above 6:1 will be tough to feed.

10. Where deliveries are important, give your suppliers the benefit of your own forecast of production volumes and requirements.

Source: Amerace Esna Corp., Elastic Stop Nut Division; Eaton Corp., Engineered Fasteners Division; Milford Rivet & Machine Co.; National Lock Co.; Palnut Co.; Standard Pressed Steel Co.

continued from page 87

and still not sacrifice productivity. Most of the assembly machine builders are used to making single-purpose equipment for high-speed long runs. That doesn't fit our needs."

"The robot may offer the ultimate in mechanized automation," claims Robert J. Glorio, marketing manager, Versatran Div., AMF Corp. "We have just begun to tap the assembly market; we are, for example, feeding welding operations. But we have made a decision to provide a complete automation system that will combine the productivity of the automatic with the flexibility of the robot where it's needed."

Huber (Admiral) says there is one important route that can alleviate the product life problem. "Many of the parts that go into electronic calculators are similar in size and shape. The more we can standardize on parts, the higher the volume will be, and the more practical automatic assembly becomes."

Huber also cites a 1974 need: "Our capital budget program for 1974 includes a complete insertion facility. We are doing some component parts insertion today, but on a very limited basis. We have been looking at equipment that is commercially available, with tape control, that we hope to install."

Williams (Eaton) also points up another trend in assembly. His division is integrating subassembly and testing, so that the final product has been thoroughly checked all along the way. "Our rework has dropped, and we have fewer returns from the field."

"Actually, we don't feel testing can be separated from assembly," says Gordon McAlpine, director of marketing, Industrial & Automation Systems Division, ITT. "We believe the sequence is gage, assemble, and test—a three-in-one process. The result is that you get rid of the bad parts and subassemblies *before* they go into the product. It is a simple concept, and it means you will get a maximum yield of good products at the end of the line."

Although there are some gripes and some problems in the moves to automatic assembly, the moves are being made despite them. Donald Lorton, corporate director of facilities planning, Whirlpool Corp., indicates the extension of the trend: "Traditionally, we have had assembly lines that started when you pushed the button and then they ran all day. It worked fine, but you have people moving in and out, trying to catch up. Then, in one of our plants, we put in an index and dwell machine. The output is the same, but we can do some simple additional things, like attaching a label, that used to be done by hand. Now, we have a machine that has a minicomputer on it, and we find we have some added flexibility. To make a change, we just reprogram the computer instead of taking days to alter a cycle."

How important is a reduction of assembly cost? In a PRODUCTION Round Table, the production managers and engineers from a variety of industries reported assembly costs ranged from 18 percent to 47 percent of their total product cost.

ADHESIVES

Slowly, but relentlessly, adhesives are working their way into

continued on page 91

LET'S GET TOGETHER

BEFORE YOU GET YOUR PRODUCT TOGETHER

Let's talk about lowest in-place fastening costs when your product is at the design or prototype stage. That's when you can benefit from value engineering as well as value analysis. And that's when a sketch, blueprint, or specification from you to us can help you put more profit into your production with Continental's broad, in-depth line of fasteners. So let's hear from you soon. You'll hear from us by return mail with a firm quote on any or all of the following products:

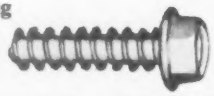
Design Tapping Out with TAPTITE® Screws

These versatile screws roll-form strong machine screw threads in drilled, punched, or cored holes in all ductile metals and die castings by displacing and compressing material . . . without forming chips! Unique tri-lobular thread shape keeps driving torque low and provides space into which the compressed material can recover to form a perfect mating thread which increases fastening strength and resistance to vibrational loosening. No tapping costs. No costly locking devices.

Design Extra Assemblies Out with SEMS® Fasteners

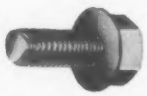
These are the pre-assembled screws and washers that eliminate an extra assembly step . . . do away with inventory, handling, and purchasing problems.

Design Galling Out with PLASTITE® Screws



These screws are similar to TAPTITE Screws, except that they have spaced, tri-lobular shaped threads. They make the strongest, surest threads in ABS, Nylon, and other ductile plastics . . . eliminate galling, boss breakage, or stripping in drilled or molded holes. Also good in soft metals such as aluminum and zinc die castings.

Design Loosening Out with POWERLOK® Screws

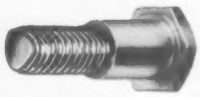


These self-locking fasteners incorporate the TAPTITE tri-lobular shaped threads with a unique 30° crest profile especially recommended for pre-tapped holes. They drive easily (can be started by hand) but have far greater resistance to backout than standard locking devices . . . exceeding IFI locking standards by as much as 400%.

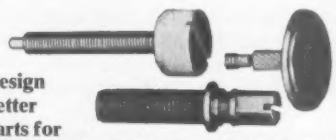
Design Holes Out with TEKS® Screws

TEKS self-drilling screws have a true drill tip with two cutting flutes that permits drilling, tapping and fastening in one operation in metal thicknesses from 1/16" to 1/4". No pre-punching, pre-drilling, or tapping. Much lower assembly costs.

Design Fastener Failure Out with CORFLEX® Screws



These high strength alloy steel TAPTITE type screws combine good bending toughness, resistance to high alternating load stresses, and the ability to easily form threads in deep, untapped holes with excellent resistance to vibrational loosening. They're the only high-strength, self-threading screws on the market to offer all the in-place cost savings of TAPTITE screws on heavy-duty structural applications!



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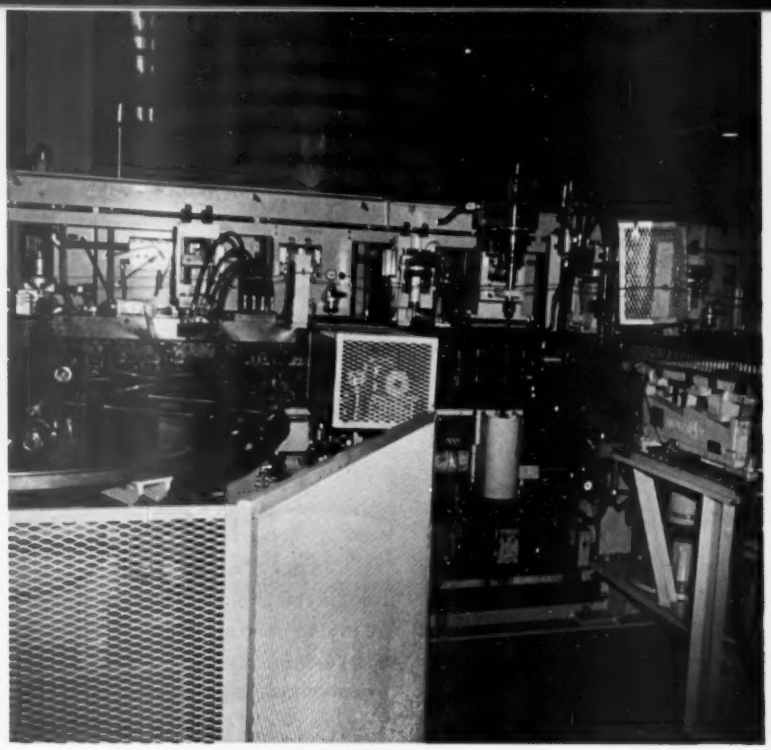

Eight assembly machines put together subassemblies and test them before feeding them to the final assembly line for brake valves at Delco Moraine Division, General Motors Co., Dayton, O. Thus, bad subassemblies are rejected before they get to the final assembly machine in the center. The system was engineered and built by Swanson-Erie Corp., Erie, Pa.

continued from page 89

metalworking joints. Where the problems have to do with the adhesive material itself, they usually are due to extremes of heat or cold (this applies in only a limited number of applications), service problems (it can't be just unscrewed and then refastened as easily as mechanical fasteners in most cases), difficulty in maintaining and handling the adhesive under production conditions (this has been a real problem), and apprehension on the part of the user (often the major barrier).

Howard Dvorak, department chief, Hawthorne Works, Western Electric Co., sums it up for most of industry: "We do use adhesives, but they have not replaced conventional metal joining in general use."

Asked about the problems in using adhesives, or epoxies, Carl Insel, director of manufacturing, Communications Division, Motorola Inc., explains: "We do use them on occasion, but we try to avoid them. The operators don't like to work with them. It is hard to retain consistency or quality. Anything we premix has a time factor applied to its usefulness; if the operator takes a break, the batch usually will not work when she returns."

There is no question that storing and applying adhesives has been a problem, agrees J. C. Hunt, market manager, product assembly, Nordson Corp., Amherst, O. "One of the solutions with epoxies is to go to the single-component epoxy. Hot-melt adhesives offer another solution. With our conventional equipment we can prevent environmental deterioration of the batch with a nitrogen blanket. In addition, the newest hand guns melt the adhesive in the gun, just before it is applied, so you have a minimum of environmental problems. We are now working on the hardware and the control for automating that application. Hot melts, by the way, are working in some applications at over 300 F; but anything over 200 F should be carefully studied."

Howard Dvorak
Western Electric Co., Inc.

The aerospace industry is undoubtedly the leader in the use of adhesives. As one wag commented: "If you don't trust adhesives in your product, take the train when you travel."

Now, the automakers are not far behind. John Haviland, senior engineer-in-charge, Materials Testing Laboratory, Fisher Body Division, General Motors Corp., says: "For years we have used adhesives for such jobs as interior trim and more recently for attaching the rear-view mirrors to windshields. What is going on now, however, is the use of adhesives for structural purposes, replacing welds and other fasteners."

There is extensive use of adhesives in car bodies. And now, maybe even in drive trains or other load-joint parts. Frank Daley, director, manufacturing development, Manufacturing Staff, General Motors Corp., said in the January 1974 issue of PRODUCTION: "I had axles running around with the ring gear stuck on more than 10 years ago. It has not become a production application because, as in many other potential applications, we have not yet solved the problem of field service where the assembly must be taken apart and then reassembled."

But F. L. Bird, manager, manufacturing engineering services, Chrysler Corp., comments in the same issue: "We have just reviewed a process that might solve part of that problem. It involves the use of ultrasonic energy to break the bond." ■

continued on page 93

3 NEW high-frequency CP* WELDING PROCESSES to REDUCE COSTS... INCREASE OUTPUT

of carbon and stainless steel products

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1 BUTT WELDING FINITE LENGTHS

of flat, cylindrical, other shapes, up to 800 pcs/hr and more. Joins coated, uncoated, and dissimilar steels .025" to .250" thick, as well as dissimilar sizes and thicknesses per weld. Welds can be heat treated, in place, with same HF current. Typical auto frame weld, 7½" joint in .118" mild steel in 1.1 sec.

Typical Application: End or side-by-side joining of stampings, strips, sheets.

2 LIP WELDING FINITE LENGTHS

of flat, cylindrical, other shapes, up to 600 pcs/hr and more. Joins two or more layers of uncoated carbon and certain stainless steels in total lip thickness up to .3". Welds can be heat treated, in place, with same HF current. Weld a 24" joint in 4 thicknesses of .050" 409 stainless in 2 sec.

Typical Application: Tank, container, muffler production.

3 CONTINUOUS LAP WELDING

of two to four layers of uncoated carbon or stainless steels up to total, multi-layer thickness of ¼", at up to 150 ft/min rates. Electrical contact only on one side of workpiece.

Typical Application: Seam welding shapes on a roll former.

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280 Fairfield Avenue, Stamford, Conn. 06902
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useful literature

continued from page 91

Selection and application of metric Taptite thread rolling screws is the sub-

ject of a 6-page brochure including tables on how to specify. (Continental Screw Co.)
Indicate No. 764 on card

The Capabilities and Commercial Usage of Explosive Welding is the title of a 14-page technical paper discussing materials that

can be joined explosively and illustrating a variety of joint configurations. (Battelle Memorial Institute)
Indicate No. 765 on card

The variety of shapes, materials, and finishes that can be achieved by cold

heading is described in a 42-page bulletin. (Elco Industries, Inc.) *Indicate No. 766 on card.* **Information to help analyze and compare end product usage** to enable correct selection of fasteners with machine screw threads is presented in a 4-page bulletin which includes a discussion of special threads. *Indicate No. 767 on card.* **Information on thread-forming and thread-cutting screws** is included in a 48-page catalog designed to assist in the specification of cold-headed fastener types. *Indicate No. 768 on card*

A thread sealing machine that wraps over 1500 connections per hour is described in a pair of 4-page

bulletins. Accommodates pipe nipples, and accessories such as dials and gages. (Crane Packing Co.)
Indicate No. 769 on card

A highly informative film entitled "The Big 85" is available for viewing in

plants involved in fastening operations. Deals with reduction of costs through use of thread rolling screws. (Continental Screw Co.)
Indicate No. 770 on card

Rivets and riveting machines are included in a 12-page brochure describing the company's services, facilities, products, and

business philosophies. Tooling and hopper accessories are included. (American Rivet Co.)
Indicate No. 771 on card

"Furnace Brazing Techniques," a 16-page brochure, describes the process, the furnace, the advantages of furnace braz-

ing, and presents the design factors and methods of handling typical assemblies. (Electric Furnace Co.)
Indicate No. 772 on card

A 36-page screw engineering guide charts such useful information as decimal equivalents, distance across corners, millimeters to deci-

mals, tap drill sizes, metallurgy, and thread dimensions. Plating and finishes and point terminology are included. (Central Screw Co.)
Indicate No. 773 on card

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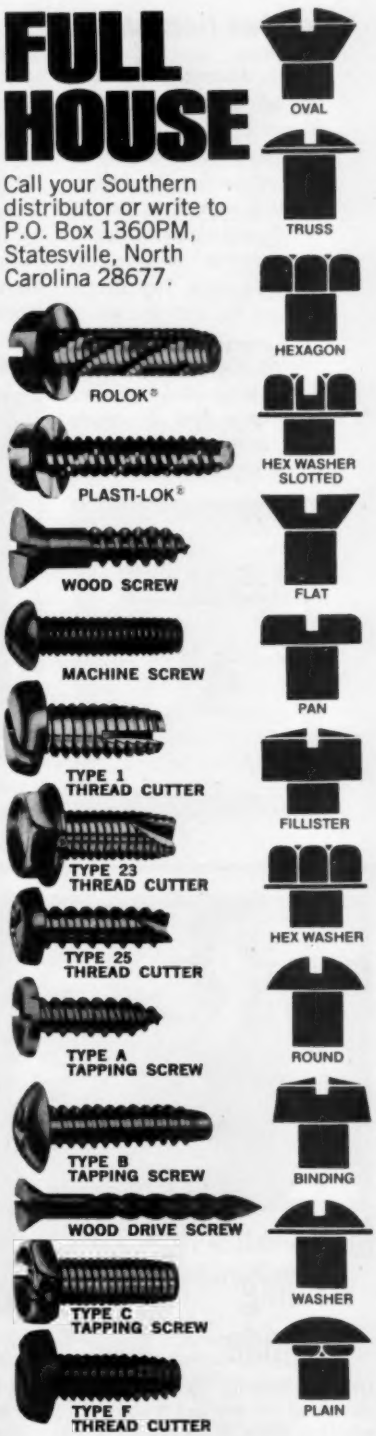

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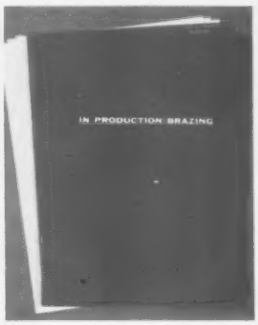
useful literature

continued

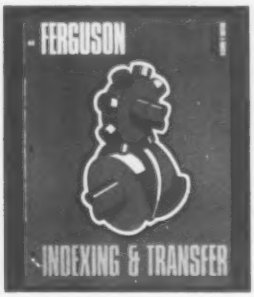
"Buhr Assembly Machine Group" is the title of an 8-page brochure which describes a non-synchronous transfer system for assembly that uses free floating pallets and standard modular machine components. (Buhr Machine Tool Corp.)
Indicate No. 799 on card

"Metric Fasteners," a 24-page booklet, explains graphically and in detail the differences between socket screws of metric and inch standards. It is designed as a guide to users of foreign-made equipment by giving instructions for selection of proper screws to replace the originals. (Standard Pressed Steel Co.)
Indicate No. 774 on card

An automated brazing information kit includes a 14-page "Possibilities in Production Brazing," a 10-page bulletin on brazing alloys and fluxes, and fly sheets showing a brazing wire feeder, a brazing ball feeder, and an automatic flux dispenser. (Handy & Harman)
Indicate No. 775 on card



Assembly machine bases are described in a 50-page catalog containing formulae and nomograms, along with examples of usage, for determining torque and horsepower requirements for rotary and in-line assembly machines. (Ferguson Machine Co.)
Indicate No. 776 on card



A 128-page technical manual covers every aspect of fastening and assembly with retaining rings. It includes dimensions and specifications for more than 50 different ring types in eight metals and five protective coatings. Explains how to calculate ring and groove load capacities. (Waldes Kohinoor, Inc.)
Indicate No. 777 on card

Resistance welding principles, equipment considerations, and tooling for automation are the subjects of a paper delivered to the American Welding Society as well as in-plant seminars. (Automated Process

MIG welding guide

New color, sound films show latest welding methods. Ask any Miller Distributor!

Here's a helpful 16 page guide to the MILLER equipment you need for any gas metal-arc (MIG) welding job. A MIG welding bible, it pictures and describes:

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Inc.) *Indicate No. 778 on card.* **Automating manual joining operations** is the subject of a paper recently delivered at an assembly seminar at the University of Wisconsin. It discusses criteria for automating manufacturing operations. *Indicate No. 779 on card*

A series of previously published technical reports are available from Shakeproof

Division of Illinois Tool Works, including: **An Economic and Engineering Justification** for the use of Preassembled Fasteners on Large and Small Assembly Lines. Eight pages. *Indicate No. 780 on card.* **Total Fastener Design** As It Can Be Achieved To Fulfill Complex Application Objectives. Eight Pages. *Indicate No. 781 on card.* **An Engineering Statement** on the Economics of Fastener Holes. Eight pages. *Indicate No. 782 on card.* **The Multiple Functions of the Basic Tooth** Lock Washer Design. Six pages. *Indicate No. 783 on card.* **An Engineering Statement** on the Relationship of Washer Design to Torque and Tension Measurements. Six pages. *Indicate No. 784 on card.* **An Analysis of Screw Assemblies** and a Classification of Metal Washers into Locking and Non-Locking Types. Eight pages. *Indicate No. 785 on card.* **Predicting the Behavior** of Thread-Cutting Screws in Plastics. Eight pages. *Indicate No. 786 on card.* **Design Considerations** for Sealing Fasteners. Eight pages. *Indicate No. 787 on card.* **Design Criteria for Spring Washers** with Controlled Characteristics. Six pages. *Indicate No. 788 on card.* **A Design for Improving the Performance** of Threaded Fasteners in Plastics. Eight pages. *Indicate No. 789 on card*

A 52-page "Machine Maintenance" manual is offered to rivet setting machine users by Milford Rivet & Machine Co. Lubrication, inspection, and adjustment instructions are divided into four major sections: power train, rivet feed mechanism, small tools, and trouble-shooting chart. (Milford Rivet)
Indicate No. 800 on card

A 6-page technical data bulletin containing metric TAPTITE screw standards, captive points, percent thread, recommended pilot hole sizes, for steel, aluminum and die castings, recommended tightening torque, and recommended shop practice for these screws in punch-extruded holes in sheet metal applications is offered by Continental Screw Co.
Indicate No. 801 on card

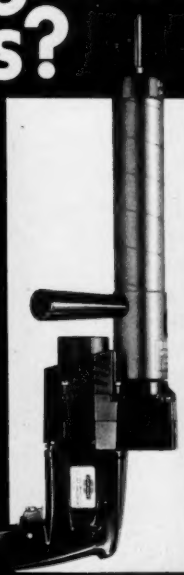
Its latest developments in smoke extracting guns and smoke collector systems are detailed in a 12-page booklet which tells how to solve the problem of removing MIG welding smoke from the welder's environment. (Bernard Division, Dover Corp.)
Indicate No. 803 on card

Special Print 486 entitled "Press-Fitting without Galling, Seizing or Fretting with Molykote Lubricants" is offered by Dow Corning Corp.
Indicate No. 805 on card

continued on page 97

Still using cold sealants?

Now you can obtain superior "*hot*" sealants with the portable PSA™ gun.



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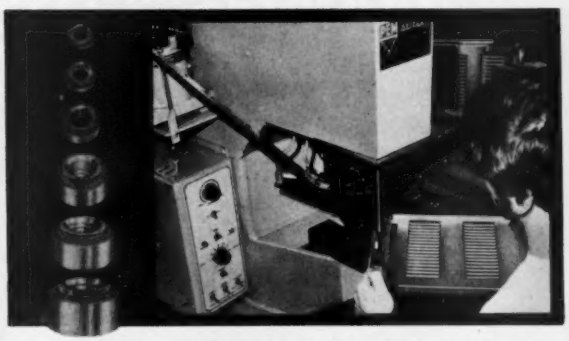

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Safety, durability, versatility, quiet operation, and other features, demanded by industry today, are designed into this new Model 124 rivet setting machine. It's the finest automatic single drive pedestal machine on the market. Starts working just as soon as it hits the floor, and keeps on working day in and day out with only minimal care and attention.

Check these features:

- Fast machine cycle rate with quiet solenoid operated clutch
- Positive rivet feed assured with transfer type cut-off mechanism
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- Rivet capacity—up to .200 diameter x ¾" length; can be 1⅛" with 9" diameter hopper

If you have to clinch rivets on fragile components, then air operated Model 124-A is your answer. A direct drive setting lever automatically senses and compensates for work piece thickness variation.

For all the facts on Model 124, write for catalog sheet.

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useful literature

continued from page 95

Complete information on how and where to use stud welding in metalworking applications, plus details on the fasteners and equipment available, is contained in a brochure offered by Nelson Division of TRW, Inc.
Indicate No. 804 on card

National-Standard Co. offers two welding brochures. "Welding Wire" outlines the cost factors involved in MIG welding, plus specifications. *Indicate No. 806 on card.* **"Weld Wire Selector"** lists physical properties and chemical analyses of numerous types of steel and recommends filler metals for various conditions. *Indicate No. 807 on card.*

Eight technical bulletins covering torque multipliers, metric tools, power drive sockets, dial torque wrenches, torque testers, ratchets and drivers are offered by Williams. (United Greenfield)
Indicate No. 808 on card

A comprehensive process manual "Pulsed Spray Welding" is offered by Airco Welding Products. Process details and parameters are included in the 72-page volume. *Indicate No. 809 on card.* **Airco** also offers three booklets on the use of MAPP gas covering flame hardening, joining, and metallizing with the gas. *Indicate No. 810 on card*

Mechanical fasteners are the subject of three brochures offered by Esna Division, Amerace Corp. "Visual Index" is a complete pictorial presentation of all standard Elastic Stop Nuts. *Indicate No. 811 on card.* **"Maintaining Tightness** of Threaded Fasteners" is a study of threaded fastener systems and the effect of vibration; it also details the effectiveness of nylon insert type fasteners. *Indicate No. 812 on card.* **"Torque-Tension Manual"** covers hexagon nylon insert Elastic Stop Nut performance and provides selection data. *Indicate No. 813 on card*

New Design Guide for B. F. Goodrich Rivnuts and Plusnuts blind fasteners gives engineering data covering sizes, materials, grip ranges, popular applications, installation procedures, and tools. *Indicate No. 814 on card*

Tomkins-Johnson offers 28-page catalog including technical application information regarding its line of heavy-duty and special-purpose riveters and clinchers. *Indicate No. 815 on card*

A series of technical reports covering pulsed current and programmed welding with the gas tungsten-arc, plasma-arc, and gas metal-arc processes are offered by Hobart Brothers Co.
Indicate No. 816 on card

"The Anatomy of a Money-Making Assembly System" is the title of a 12-page brochure on cost-saving approaches to automation and the basic components available in a Bodine Model 64 Modular In-Line Assembly Machine. *Indicate No. 817 on card.* **A companion piece** offered by Bodine is a 32-page guide to planning and tooling for combined metal-cutting, assembly and inspection operations on a single high-speed dial-type production unit, entitled "Machines and Methods." (Bodine Corp.) *Indicate No. 818 on card*

Specifications of Page welding conduit for semi-automatic welding are given in a data sheet offered by Acco. Available lengths, IDs, construction, and end fittings are covered. (Acco, Page Welding Division)
Indicate No. 820 on card

An 8-page brochure on the art of arc welding which covers metals and types of processes is offered by Taylor-Winfield. The brochure discusses construction, controls, and production performance for a wide variety of automatic machines.
Indicate No. 819 on card

Design your own locknut is invitation contained in the technical reference section of a comprehensive brochure on metal locknuts. (Everlok Division, Microdot Inc.)
Indicate No. 821 on card

Four manuals and catalogs on epoxies and sealants are offered by Hardman Inc. **Epoxies and auxiliary products,** *indicate No. 822;* **castable elastomeric compounds,** *indicate No. 823;* **DPR flowable rubber,** *indicate No. 824;* the **profit dispensers,** describing machines for metering, mixing and dispensing epoxies and urethanes, *indicate No. 825 on card.*

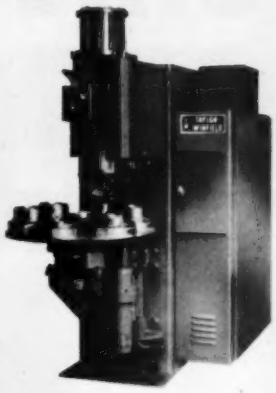
A 24-p. catalog of heavy-duty air tools for industrial use is offered by Black & Decker.
Indicate No. 826 on card

Vibratory parts feeders are described in a 44-p. Syntron booklet. *Indicate No. 827 on card.* **Screwdriver systems** from Detroit Power Screwdriver are covered in a 20-p. booklet. *Indicate No. 828 on card.* (Syntron and Parts & Material Handling Division, FMC Corp.)

Air-operated portable tools and accessories are described in 22-p. catalog. (Desoutter, Inc.)
Indicate No. 829 on card

Automatic soldering systems for printed circuit boards and similar products are depicted in a 12-p. brochure. (Industrial & Automation Systems, ITT)
Indicate No. 830 on card

Resistance Welding Systems



By Taylor-Winfield

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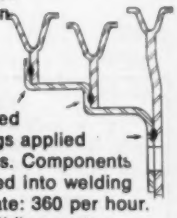
Six Station Dial Feed System and 150kva Tri-Phase Welder uses new concept to form pulleys from deep drawn hubs and pre-spun rings.

Cross section illustrates positioning of rings on hub. Eight projection welds to each of three rings fuse elements into a strong, solid unit. Hubs manually loaded on six stations. Rings applied in proper sequences. Components continuously indexed into welding head. Production rate: 360 per hour.



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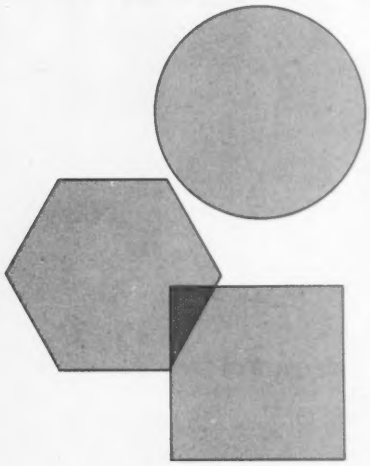

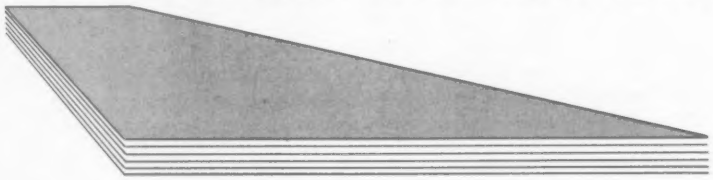

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- ☐ UNILOY HC Corrosion Resistant Alloy (Circle No. 302 on Reader Service Card)
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TOOL AND DIE STEELS

- ☐ UNICUT High Speed Steels (Circle No. 304 on Reader Service Card)

TOOL AND DIE STEELS (Con't.)

- ☐ MOTUNG 652 High Speed Steels (Circle No. 305 on Reader Service Card)
- ☐ UNIMAR 300K Maraging Steel (Circle No. 306 on Reader Service Card)

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- ☐ Machining of High Temperature Metals (Circle No. 307 on Reader Service Card)
- ☐ High Temperature Metals Reference Card (Circle No. 308 on Reader Service Card)

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What's happened in materials availability in the past nine months is proof that a semi-controlled economy does not work very well. It became, in fact, a planner's nightmare.

Stripped to its essentials, we had a booming economy that had recovered from its brief recession and in practically all sectors was operating at its practical capacities. Working at cross-purposes to it was—

- A price-control mechanism that wasn't applied across the board but was most stringent against such high-visibility and large industries as steel and aluminum.
- An environmental/ecology movement, coupled with tough national and local laws, that required many of the basic materials-producing industries to concentrate much of their capital spending in non-productive directions, forced many marginal producers, primarily small foundries, out of business, and made proposed new plants in many sites unwelcome.
- An energy crisis that encompassed electricity, natural gas, and petroleum and its derivatives.
- And, to top it off, a hodge-podge of foreign trade objectives that sought on the one hand to limit our imports and encourage our exports while also developing new trading partners and trying to foster freer world markets.

It was inevitable that the "system" developed severe cracks.

It's far from clear how it will be reassembled. But until it is, people in manufacturing will be playing by an entirely different rulebook than the one that always before had governed.

Wartime with a Difference. The situation with materials has been likened to that of wartime, with chronic shortages, allocations, transportation disruptions, and under-the-table dealings.

But the analogy is faulty. There's no "czar" deciding what industries are essential and are entitled to predetermined amounts of material, what production schedules they'll meet, what profit margins they'll get. There's no reduction in the variety of products being manufactured, no let-up in domestic and foreign competition, no mandate "to get production out at *any* cost."

It's an unparalleled situation, with no short- or long-term solutions in sight.

Working in your favor is the fact that strong competition among materials suppliers exists. They want your business on a long-range basis. They realize better than ever before that they're competing not only with companies making the same materials they do but also with companies producing entirely different materials, of which there's a greater variety than ever before.

Also in your favor is growing acceptance of world-wide sourcing. You're almost as likely to consider a potential materials supplier located in a different hemisphere as one in a different county or state.

Government Holds the Key. You'll, however, continue to be plagued by shortages of virtually everything your company buys until one of three things happens: demand, in total and on a world-wide basis, recedes substantially from its 1973 level; supply is increased through construction of new capacity in the basic materials-producing industries; prices are permitted to rise domestically to the levels commanded in world markets. The last two points are closely inter-connected.

Looking at each materials-supplying industry, there are different governing factors. But the most important ones are government-generated: pollution abatement, price control, and energy and oil allocation.

The shortage of foundry products, which is universally regarded as the most critical, is caused by the demise of thousands of foundries, whose owners decided they could not or would not meet the clean-air restrictions imposed on them. The fuel pinch compounds the remainder's difficulties. About one-third of the steel industry's capital investment dollars are going into pollution-abatement efforts. Somewhat the same fraction of the total is being spent to replace obsolete and/or pollution-generating facilities, leaving relatively little for additional capacity.

On the price-control side, the steel and aluminum industries, particularly, were "caught with their prices down" when government controls were instituted. Steel was under heavy competition from foreign producers, and aluminum was over-capacitized going into the recession and was selling

Two winners on the automotive battleground for lighter weight materials: Chevy Vega's all-aluminum bumper, left, made by Reynolds Metals; and the Pontiac Grand Prix rear end panel made of GE's Valox

its products at "distress-merchandise" prices when the boom came on. Neither industry is willing to increase its capacity to the apparent current demand level at today's low profit margins. Furthermore, when significant expansion comes, it will be next year or the year after before it can ease the availability problems.

E. F. Stebbins, vp-operations, Iron & Steel Division, Interlake, Inc., describes the problem: "We work very hard at modernization, but it becomes more difficult in times like these. Most of our replacement of facilities and modernization programs are in on-site situations. We are crowded in our Riverdale and Kentucky plants, and obviously in our blast furnace plants at Chicago and Toledo; this means that essentially you have to take an existing piece of equipment out of operation in order to put a new piece in. You obviously are going to lose some production during this period."

Compounding the situation for the steel industry were the dollar devaluations, which suddenly made imported steel unattractive on a price basis; the rising world demand for steel; and absence of price control on imported finished material and on exported scrap.

In consequence, U.S.-produced steel and aluminum are bargains to foreign consumers. One of the important raw materials to both, scrap, is commanding record prices in the domestic market and even higher figures in export markets.

Similar situations apply to copper, zinc, tin, gold, and all the other metals on which industry depends.

Until late last year, plastics were the leading runner in the race for alternatives to metal. Aside from their functional advantages, which often from a manufacturability standpoint could offset their price disadvantage as compared, at first, with zinc and aluminum die castings and sometimes with stamped steel assemblies, here were the materials that were finally coming into their own in the 1970-1980 decade. Their producers were significantly expanding their capacities. User technology had improved. New product designs were capitalizing on the materials' unique properties.

Then they ran head-on into the oil crisis.

Howard Dvorak, department chief, Hawthorne Works, Western Electric Co. Inc., has seen this shortage suddenly appear: "We have run into shortages of plastic parts as our suppliers fail in their deliveries."

Imminence of the same problem is mentioned by Charles F. Mores, vp-manufacturing operations, Signode Corp.: "It looks like plastic strapping will be a problem in 1974. Right now, in non-metallics, our problem is inability to supply the demand for our manufactured product, but it looks like the plastics will be even tighter later on, and we may get into a raw materials supply problem."

Difficulty with finding substitutes for presently used plastics is a source of worry to John S. Secker, assistant general manager, Micro Switch Division, Honeywell, Inc., and to L. Paul Williams, manager, manufacturing, Controls Division, Eaton Corp.

Says Secker: "We haven't yet seen a shortage of plastics, but we're investigating the rumors. We don't know what our recourses could be if the shortage develops. We're deeply committed to plastics in many of our products, and we would be hard-pressed."

Says Williams: "As of right now, DuPont has advised us that we are covered at the same level as for the previous 12 months. And we have been advised by our polyethylene suppliers that we are covered, but in the same breath, they're also saying: 'Look out.' We're told also that neoprene is on allocation.

"We have gained customer acceptance of the plastics we are using, and if we are going to have to make a change, it cannot be done overnight. We use some highly specialized plastics because of the water environment in which our products operate. A major shortage of resins would put us right up against the wall. We went to plastics to get out of brass and zinc die castings; to go back would be almost impossible."

As 1974 dawned and the oil crisis tightened, plastic makers retained their public optimism, promised their regular customers shipments on the basis of 1973 volumes providing the plastics-making raw materials would be available from the oil refineries, but privately conceded their growth rate will be slowed.

There was a swing back to zinc and aluminum die castings, although skyrocketing prices made the decision a difficult one for many users.

In looking at the comparison between plastics and die castings, Larry Levine, manager, manufacturing engineering, Hotpoint Co., says he expects much the same supply problems from plastics vendors that they've had in obtaining die castings.

Impetus for Change. In such a sellers' market, a decline in product development activities by the materials producers might be expected. That, however, has not occurred. Materials producers, in fact, have intensified their development of special-purpose materials, particularly for applications where the potentials seem greatest or where the danger of losing important markets to totally different materials threatens.

According to a General Motors man, the best recent thing that happened to grey iron foundry technology was GM's decision to go to aluminum for the Chevrolet Vega engine.

Likewise, the automotive industry's need to take weight out of cars and its development of impact-resisting bumper systems have brought totally new considerations into the materials selection process. An aluminum extrusion now is used for Vega bumpers, while, elsewhere, new lightweight, high-strength steels have appeared for bumper and frame reinforcements, support brackets, and similar members.

Aluminum and foam structural plastic are under active consideration for exterior automobile body panels, with foam plastic appearing to have the edge and slated for use in some low-volume hoods and decks this year. Structural foam already is appearing in place of sheet metal in American Motors' glove box door. And looks like it will run sheet metal and die castings right off the map for office machine housings.

With lighter weight and corrosion resistance strong selling points for aluminum and plastics, the steel industry has countered by developing new galvanized products for a wide variety of applications and is plastic-coating steels to keep them in strong contention.

Material conservation, always a strong motivation but doubly so in a tight materials market, is making more urgent the exploration of powder metals in larger parts, with significant breakthroughs considered imminent. Availability of larger quantities of powder metal at a time when disruption of plastic supplies is threatened adds to this material's attractiveness in many new directions.

"We've done some substituting with powdered metal parts," reports J. W. Rose, vp, Metal Products Group, Bliss & Laughlin Industries "but our parts tend to be small. Our demand is not large, and our sources are responding well. I don't know whether our situation is typical, but we've had good deliveries in these products."

Charles Mores
Signode Corp.

Aluminum producers, as a group and singly, have been prompt to exploit the materials conservation angle and its relationship to energy conservation. While virgin aluminum requires more energy to produce, initially, than steel (1.3 to 1), its recycled use needs only 5 percent as much energy. Its high scrap value and heavy use in such easily recycled products as cans are giving it an extra margin of current acceptance.

Many end-product producers, of course, feel that they cannot change from their traditional materials because of strong customer prejudice.

Julius Vetter, president, Louis Allis Co., points up the difficulty of trying to break away from tradition. "The hardest thing about trying to get away from iron castings is that Americans still like to buy bulk. I sell castings—I sell electric motors sitting in castings.

"Let's face it, we are not in business to sell what we think is best. We are in business to sell what the customers think is best. And if they think castings are better, there is no sense spending a lot of money and time investigating alternate materials."

Other executives, however, feel that sudden change from normalcy now is less disturbing to the consuming public—including hard-nosed corporate buyers—than it would have been a year ago.

How to Cope. A key question in proposed redesigns or initial new product designs of new products now must be: Is the desired material available? And two corollary questions which must be answered to a prospective supplier's satisfaction are: In what quantity will we need the material and over how long a period of time?

"There are a lot of questions in-

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men because they've For you and for us.

Having our salesmen tied to the phone answering questions about the status of your order wasn't a good way to get results for you or for us. So we decided on a better way.

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volved," says Donald Lorton, corporate director of facilities planning, Whirlpool Corp. "In the design of our product we have to look at the impact of commodities. Should we make switches? What are the alternatives? And if we move to a particular material—say, a commodity that now requires a lot of finishing—then we have to face up to the energy and environmental problems."

As long as the over-all shortage situation lasts, prospective suppliers are looking for, and looking out for, long-range customers, whose needs are reasonably predictable and who have good prospects for growth.

In recent months, the materials industries have put their regular customers on more-or-less formal allocation systems, while they've also concentrated their market development activities in areas that seem to promise the largest long-range potentials.

Ron Gallagher, vp and plant manager, Sturdi-Bilt Materials Handling Division, UNARCO Industries, Inc., says: "There really is no place to go. Mills will not make light gages for us in hot-rolled material. All they're thinking of is tonnage, and they can get a heck of a lot more tonnage by rolling 12 gage than by rolling 15 or 16 gage. Our choice is to use the new higher strength steels in the light gages."

For companies without large tonnage requirements, the problem seems to be particularly intense. Monte Craig, vp-manufacturing, Skil Corp., says: "Steel availability concerns me more than almost anything. It's very difficut for small users like ourselves to compete for steel. While we're not major consumers, we're still big enough that we buy directly from mills."

Explaining the steel industry's problems and his corporation's objectives, E. F. Stebbins (Interlake) asserts: "Our operating and sales objectives for 1974 are to retain those customers we have and to deliver to them the qualities and

Monte Craig
Skil Corp.

the quantities as best we can within our capabilities. We feel that the only protection for our business in the long run is to do a good job for those people who have been close and friendly customers over the past years."

The steel industry was able to make its record level of 110 million tons of finished steel shipments in 1973 by pulling 6 million tons from a now-exhausted inventory. The shipment rate will, therefore, not be sustained in 1974; a short-fall of about 8 million tons, including imported material, is anticipated. Imported steel tonnage has been declining since its price skyrocketed. And the amount to be imported in 1974 is estimated at 12 million tons.

"We've maintained, I would say, reasonably good deliveries against promises by depleting inventory," explains E. B. Stebbins (Interlake). A steel and merchant iron supplier, Interlake's iron inventory dropped last year from 141,000 tons to around 46,000 tons, and the same is true, he says, of the company's steel inventory. "We have depressed both our semi-finished and our finished goods inventories to levels well below what I am comfortable with. The trend toward 'off-the-shelf' deliveries to customers is disappearing, and we just can't produce at the rate our customers currently require steel."

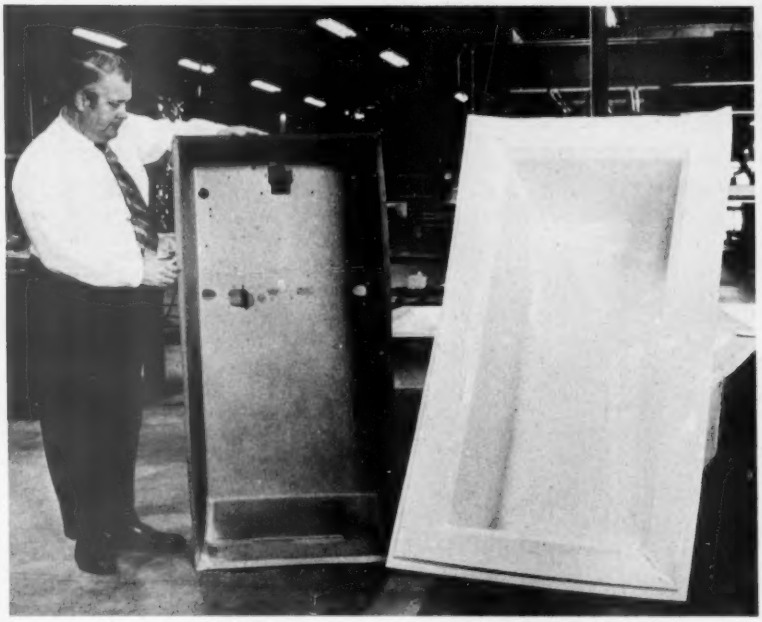
E. F. Stebbins
Interlake, Inc.

The cutback in automobile production schedules and the decline in housing construction will afford some relief from the steel, castings, and forgings shortages; and as other industries are adversely affected by energy shortages and consumer hesitancy, the current general imbalance between supply and demand for virtually all maaterials may see some reversals. The materials suppliers, however, will be having their own production problems and may not be able to maintain output at 1973 levels.

Aggressive action by managers of materials-consuming companies will be needed if their operations are to be sustained. What kinds of aggressive actions are possible and in order?

The most important single move, everyone agrees, is to develop the strongest possible ties with your suppliers. This may involve bargaining with your scrap, and some of the elaborate conversion deals that sprang up in wartime may be a possible way of helping a supplier out of his problems and capacity imbalances. James McCarthy, manager of manufacturing, Thor Power Tool Co., says: "Some of the (forging) vendors have advised us they have forging capacity if we can provide the steel. And, in some cases, we've been able to do this." Bliss & Laughlin's J. W. Rose concurs: "We're running into this with small suppliers. We find if we can offer them our scrap, rather than sell it in the open market, we can establish pretty good lines of supply."

You'll also want to make long-term commitments with them. Late last year, many important



To beat 'em, join 'em. U.S. Steel proposes a new way to make refrigerator liners: Use a thin vacuum-formed plastic skin over a 24-gage cold rolled steel liner. The plastic weighs less than one-fifth what an all-plastic liner would weigh, and the steel costs about one-quarter plastic's cost per lb

materials consumers were saying that they had given their key suppliers firm orders for their 1974 requirements, and some have given two- and three-year promises. Materials that early last year had had three-, four-month leadtimes suddenly went to a year, a year and a half, and longer. "Our tightest area and perhaps the tightest one for industry generally is castings," says Peter R. Gilezan, director, Operations Analysis, Group Staff Services, Chrysler Corp.

"Here, we're trying to respond to the problem in two ways—our in-house molding and casting capabilities, and drawing from outside suppliers.

"With outside suppliers, we're making long-term commitments far beyond what we in industry have done before—three to five years. And we're utilizing casting capacities throughout the world. If there's an increment of capacity to be had, it's from outside suppliers. To expand our own in-house capabilities is not only expensive but it's also slow to come on-stream."

"We have been working on what we call blanket order policies for a year," says Robert H. Yanker, plant manager, Barber-Greene Co. "What we now do is try to forecast for a year, and buy accordingly. We are dealing with the same vendors, and this helps establish a very good relationship." James McCarthy (Thor) is following the same approach: "We have exploded our requirements through 1974 in our more critical materials areas —forgings, castings, and so on. We want to give our vendors an indication of our needs so they can do a little better planning on our behalf."

"While our orders are subject to change, we let the vendors know that we are serious and that it is our intention to purchase their materials in these quantities and we want to continue them as good suppliers."

There's no such thing as hand-to-mouth *buying* in such circumstances. Chrysler's Peter Gilezan says the problem is finding some way "to get seven days worth of materials in seven days. Right now, the difficulty is that we're using six or seven days to get five days' supply."

To the greatest degree you can risk, keep your materials *flowing* on a hand-to-mouth basis, allowing for the likelihood of slowdowns from normalcy in your transit methods.

If some of your needs look like they'll be decreasing, give your supplier this information at the earliest possible moment. He'll appreciate the favor.

Tie your computer in with your suppliers' computers. Materials releases will be faster and can be virtually automatic at both ends.

If you can, design your products to be manufactured in several alternative materials. Sudden surpluses of materials are almost as likely to crop up this year as sudden shortages. Watch supply and price trends carefully. Many user companies as a matter of course now are publishing materials trend reports and shortages reports for their people's guidance. Tell everyone you talk to what you're looking for; there'll be a lot of spot deals for scarce materials made this year based on such knowledge.

Western Electric's Howard Dvorak points out that AT&T's Bell Labs watches the markets and sources of supply very closely. "Whenever we get in a situation like this, we generally have the resources to find some ways around it; this is standard procedure in all our operations," he says.

"We are constantly looking for materials that will perform as electrical contacts, where now we're using much precious metal. We're trying to reduce our needs for those materials that are becoming hard to get. While we don't use tremendous quantities, we're looking for things that will reduce our demand and still be able to perform to the standards that our products must have," he reports.

Caterpillar Tractor Co.'s manufacturing manager at its Aurora, Ill., plant, Charles Eberhardt, mentions his company's manufacturing development group also in this connection. "We are looking every day at fabrications versus

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Republic goes a step further in strand casting to help you get a step ahead of competition.

Major improvement in quality.
After rolling to 3" sq.
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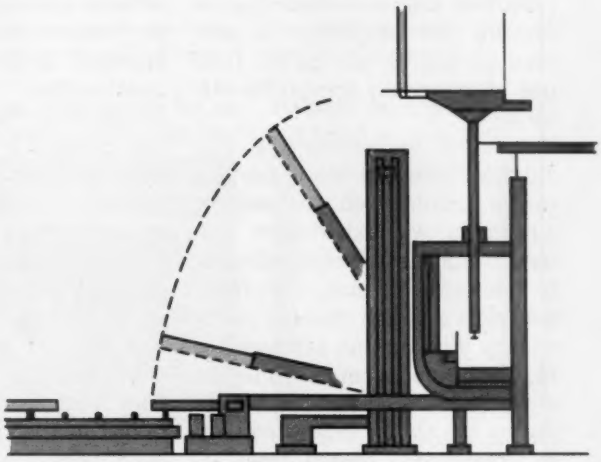
Our objective: to supply strand cast steel that will help you cut costs and increase your processing efficiency, so you can compete more effectively in your marketplace.

How? By going beyond conventional strand casting operations to develop an improved method that produces aluminum killed steels for billets and bars with better surface quality, sound centers, and less chemical segregation. With physical properties as good as or better than conventionally cast products.

To supply the top quality bars you need, we now have the latest, most modern strand casting facilities in the industry. And from the world's largest electric furnaces making alloy and stainless high quality steels, we are producing heats of 250 tons in less than four hours.



Lay-down operation eliminates bending and straightening.

Billets are flame cut to length and laid down directly to the run-out table. No bending or straightening operations. Providing greater end-to-end grain structure and chemical uniformity.

And to ensure you fast delivery, our strategically located bar mills are geared up to get the right bars to you, in the quantity you need, at the time you need them.

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castings, and the situation at given moments will justify what we do.

"In this on-going manufacturing group, they are constantly working on both the short-range and long-range approaches to overcoming some of these shortages. As fast as improvements come along and we can procure the new material, we set up an effective date; and when the former material is exhausted, we swing over to the new."

Give your suppliers as much dimensional tolerance and/or chemistry leeway as you can. Material rejected by a specification-happy customer may be suitable for your operations, but don't take such risks that your manufacturing operations will be slowed or your product quality will suffer from use of marginally acceptable material.

Look for value-enhancing substitutions. Vendors are in position to be uninterested in possible customers with short-term materials problems; they're extremely interested in ones that likely will use a different material permanently if it pans out satisfactorily in the given application. Value analysis hasn't been forced into hiding by the strong sellers' market. It remains one of the most effective material conservation tools and avenues to greater process utilization available today.

The question as Jerome Kriva, vp-manufacturing, Hydraulic Components Division, Rexnord Corp., sees it remains an economic one. "There certainly are alternative processes and materials available to us, but are they economically feasible?

"We've all spent a lot of money for research into the durability and life of our products made with historical materials. In the past, castings have been the easy way and the most economical way out for us. Where we have products that we can make as well from steel fabrications, and where the technology is such that not much research needs to be done, it becomes possible to substitute.

L. Paul Williams
Eaton Corp.

"But where it's necessary to go into a full-scale research program—for example, determining whether plastics are substitutable for scarcer materials—such an approach at this point might be questionable."

Eaton's L. Paul Williams agrees that changes to use plastics or to avoid plastics if they drastically tighten in supply would not be easy—"it's not going to be done overnight," he warns.

Emphasize standardization throughout your organization. Vendors want to get maximum tonnage, maximum production runs. They want to ship bulk. Take materials in the largest vendor-supplied packages you can accommoderate for most efficient handling at the vendor's and at your ends. Don't work at cross-purposes with your inventory objectives, but through selective standardization you may be able to bring your over-all inventories down, give yourself greater manufacturing flexibility, and give vendors the large-bulk orders they love.

Examine your product line. You may now have better justification for rationalizing your product variety on the twin grounds of avoiding the odd-ball materials requirements you may have and the higher equipment utilization you can get if identical product runs can be lengthened. The customer still is king for most industries, but he's a more dollar-conscious king than he's been for some time. He may now be looking more for value than impressed by variety.

Look to overseas suppliers. Where price is of less importance to you than supply, you probably can find new foundry, forging, and diemaking sources abroad. The energy impact and the possibility of recession are greater overseas than in this country, and a heightened interest in U.S. business is in prospect. Quality of such products, most users say, is entirely satisfactory although shipping delays may be encountered.

The director of manufacturing for the Communications Division, Motorola, Inc., Carl Insel, reports that his organization is going offshore for castings and for dies. "Some of our critical parts now are coming from Portugal, and we're getting dies from Canada," he says, adding: "The quality is top-notch.

"Originally, our interest was primarily in price. But lately, we've been looking for availability—for alternate sources of supply. Price is less of a consideration."

Bliss & Laughlin's J. W. Rose concurs: "The price today is not necessarily better than for U.S.-made products. But with supply as difficult as it is, you may be willing to pay as much or maybe a little more."

Put real teeth into your first-stage quality control activities. As products take form in your production operations, they grow in value and in usage of many now-scarce materials. Effective materials yield takes on greater urgency for you even perhaps at the expense of maximum equipment utilization. Also, if there's a point where the product can best be salvaged for rework, that area of your total manufacturing operation may be deserving of a hard, new look for ways of bringing the product up to passable quality.

There has never been greater incentive for materials conservation programs, and this should include the way stamped parts are nested, particularly if the material now is being purchased in larger size

forms. Just as turning out lights in an area that's not occupied suddenly has stopped raising jeers, looking carefully at the form and quantity of your scrap and finding uses for it may win you some points with suddenly materials-conscious management.

"Every good stamping plant has a program for cutting down its offal," Harold Bogart, Ford Motor Co.'s director, Manufacturing Engineering & Technical Systems Office, advises. "But we must continue to look at offal as being completely wasted and be satisfied only with as little removal from the rough to the finish as we can get. This means, of course, greater precision in our forgings and castings and in our stampings."

Get Help Where You Can. There is never a bad time for a manufacturing planner to study in detail where the materials go in his organization. But there are some better times than others to make this a top-priority project. You can get help for this from people who in other times might not want to be bothered. And your materials suppliers are extremely eager now to help you use their materials to the best possible advantages.

Good hunting! ■

useful literature

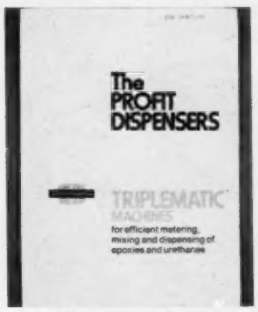
Extrusion equipment and procedures for ABS resins are described in a 10-page technical bulletin. (Borg-Warner Chemicals) *Indicate*

No. 669 on card. **Fastening, bonding, and thermal welding** assembly techniques for Cycolac brand ABS are described in a 22-page brochure. *Indicate No. 670 on card.* **The advantages of Cycolac ABS** are presented in a handy 6-page fold-out guide. *Indicate No. 671 on card.* **Coatings to provide decorative effects** or to improve functional requirements of Cycolac and Cycoloy are described in a 16-page technical bulletin. *Indicate No. 672 on card*

A list of current publications and films distributed by the Lead Industries Association, Inc., is included

in a 12-page booklet. (LIA) *Indicate No. 673 on card*

Triplematic machines for efficient metering, mixing, and dispensing of epoxies

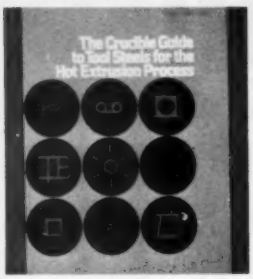


and urethanes are described in a series of data sheets packaged in a folder. (Hardman) *Indicate No. 674 on card*

A high-strength low-alloy steel for forming complex shapes by moderate draw-

ing or severe bending is described in a 4-page brochure. (Republic Steel) *Indicate No. 665 on card.* **Cold finished free-machining steel** is described in a 20-page brochure. *Indicate No. 666 on card.* **High-strength steel bars,** specially processed and stress relieved, with 100,000 psi minimum yield strength, are described in a 16-page brochure. *Indicate No. 667 on card.* **Fine-grained gear steel** that lengthens tool life for gear cutters is described in a 4-page folder. *Indicate No. 668 on card*

Tool steels for the hot extrusion process are de-



scribed in a 14-page guide. (Crucible Inc.) *Indicate No. 686 on card*

Design ideas, rubber property definitions, and suggested uses for nine groups

of elastomers are presented in a 32-page bulletin. (B. F. Goodrich Chemical Co.) *Indicate No. 675 on card.* **Properties, characteristics, and applications** for Geon dispersion resins in plastisol and organsol formulations are described in a 16-page bulletin. *Indicate No. 676 on card.* **Physical properties** of characteristic Geon vinyl rigid extrusion compounds, and chemical resistance data, are detailed in a 12-page bulletin. *Indicate No. 677 on card.*

Structural foam, what it is and how it is made, is dis-

cussed in a 20-page brochure. (General Electric Co.) *Indicate No. 683 on card*

Equalloy steels designed to achieve the same properties as the 8600 and 4100 alloy steels but at considerably less cost are described in a 24-page brochure. (Wisconsin Steel) *Indicate No. 684 on card.* **A list of**

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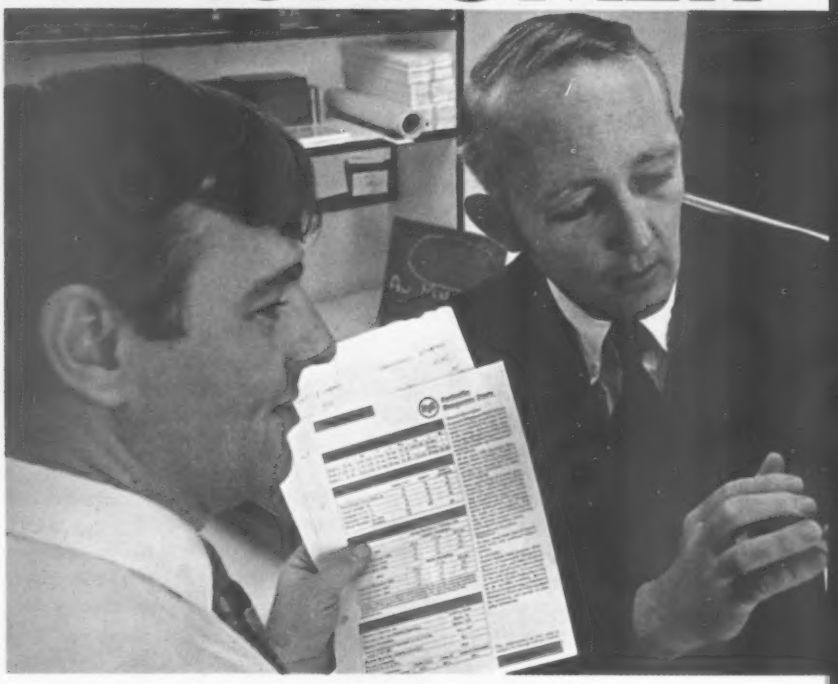
HOW U.S. STEEL SAVED A CUSTOMER $200 A TON!



One of our customers, a well-known manufacturer of large power transformers, was using a special high-alloy plate steel because of its non-magnetic properties.

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Pete Taylor got to thinking about this. He's a Metallurgical Engineer at our local office and he knew that our Austenitic Manganese steel met the non-magnetic requirements—with a greatly reduced nickel content.

He pointed this out to our customer—who determined that the saving amounted to $200 a ton. At 400 tons a year, that's $80,000 saved!

Saving you money, whether you're a big customer or small, is just one thing our operating people and metallurgists are constantly trying to do. That's why they're out in the field so much of the time—testing, evaluating, solving problems.

They're ready to help you find ways to deal with your problems. Talk things over with your USS Sales Office, or write: United States Steel, Box 86, Dept. C232, Pittsburgh, Pa. 15230.

USS TRADEMARK **United States Steel**

useful literature

continued from page 109

standard alloy and carbon steels is contained in a small, pocket-size booklet for handy reference. *Indicate No. 685 on card*

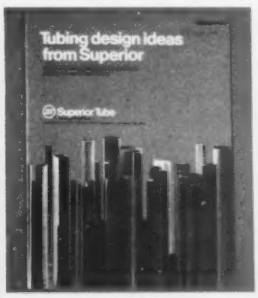
A 54-page selection guide is designed to help select the best suited and most eco-

nomical bar stock for a given application. (U.S. Steel Corp.)
Indicate No. 687 on card

A series of three informative, factual, die casting alloy fact books outline the

parameters of die casting aluminum, zinc, and magnesium. (Doehler-Jarvis Division)
Indicate No. 688 on card

Tubing design ideas, and answers to design and fab-



rication problems in using small tubing, are presented in an 18-page brochure. (Superior Tube Co.)
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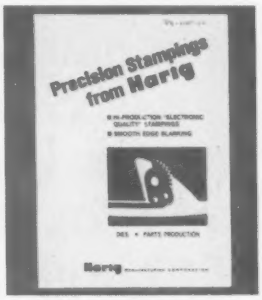
New magnesium alloys are discussed in an 8-page

paper. (Battelle Memorial Institute)
Indicate No. 690 on card

Precision stampings produced by the smooth-edge blanking process are dis-

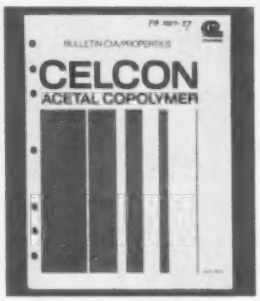


cussed in a 4-page brochure. (Harig Manufacturing Corp.)
Indicate No. 691 on card

Three helpful pieces of technical literature are offered by Universal-Cyclops: **"Machining of Stainless Steels,"** a 38-page pocket size booklet written in everyday shop language. *Indicate No. 403 on card.*

High Temperature Metals reference card, a handy 3 by 5 in. fold-out card providing analysis information. *Indicate No. 404 on card.* **A handy pocket size card** describing electronic, magnetic, and electrical alloys. *Indicate No. 405 on card*

The properties of Celcon acetal copolymer are described in a 30-page brochure. (Celanese Plastics



Co.) *Indicate No. 692 on card.* **The properties and processing characteristics** of general-purpose and heat-stabilized nylon resins for injection molding are presented in a 26-page bulletin. *Indicate No. 693 on card.* **Balancing unique performance** requirements against cost limits of both unreinforced and reinforced grades of resins are discussed in a 6-page fold-out. *Indicate No. 694 on card*

Steel analyses and useful data on carbon and alloy bars, rods, wire, and semi-

finished products are contained in a 54-page pocket-size booklet. (Bethlehem Steel Corp.) *Indicate No. 695 on card.* **An 18-page tool steel selector** booklet includes a section on typical metallurgical properties. *Indicate No. 696 on card.* **Sheet steel products** ranging from automobile frames to children's scissors are described in a 40-page booklet. It describes lamination steel, and uses of prepainted stock. *Indicate No. 697 on card*

Comprehensive catalogs on seven types of steels produced by Armco are offered; **coil-coated,** *indicate No. 698;* **high-strength low-alloy,** *indicate No. 699;* **enameling iron,** *indicate No. 700;* **stainless steel pipe and tubing,** *indicate No. 701;* **electrical grades,** *indicate No. 702;* **zinc-coated,** *indicate No. 703;* and **aluminized Types 1 and 2,** *indicate No. 704 on card.* Armco Steel Corp.)

Data sheets and application ideas on three types of steel, Duxtal coated, YO-Flex 90 galvanized, and YS-T high-strength cold-rolled are available. (Youngstown Street & Tube Co.)
Indicate No. 705 on card

The line of mechanical tubing produced by U.S. Steel in stainless, alloy, and carbon grades is covered in a 20-p. booklet.
Indicate No. 706 on card

Metric and English physical properties of steel wire are provided on a data sheet. *Indicate No. 624 on card.* **Selection factors** for music wire, stainless steel and specialty spring wire are covered in a 24-p. catalog. *Indicate No. 625 on card.* (National-Standard Co.)

Complete selection guide to stainless steels is offered. Joseph T. Ryerson & Son, Inc.)
Indicate No. 626 on card

A value analysis manual on cold-finished bars contains in its 50 pages a section on how to select materials for parts. (LaSalle Steel Co.)
Indicate No. 627 on card

Testing Goes Automatic AND Manual

Testing and inspection gets to be a more important subject on almost a daily basis because of product liability dangers, development of automated processing methods, greater interest in materials utilization, greater employee involvement through inspection of his or her output, and preliminary work with metricated products. Additionally, under today's shortage conditions, there's greater need for checking quality of incoming materials.

It is significant, and a tribute to the progressiveness of the makers of inspection/measuring/testing equipment, that most companies consider this vital area in their manufacturing to be reasonably well under control.

It also is significant that more companies now look at the devices to ensure control of quality not as separate entities to be added to a processing operation almost as an after-thought; these devices now frequently are treated as essential and integral parts of the processing operation, occasionally even controlling the operation.

For years, industry men have been talking about providing quality control on a "total" basis. By this they mean product design with obtainable performance and manufacturing specifications clearly determined, followed by manufacturing operations capable of producing components within the required specifications and monitored to assure this, with the product final-tested to verify performance. Manning these operations are a workforce and supervision that regard the quality of output as important as the volume and the cost of that output.

External and internal factors are pushing companies very close to this total quality control concept.

One external factor is the consumerism movement with its demand, and sometimes its legal requirement, that each product be flawless. Another is foreign competition, notably from Japanese-made products where the quality-consciousness of the average workperson is a source of American managers' envy and where automatic testing and inspection are believed to have progressed beyond that practiced in many American companies.

The internal factors are even more important. Better identification of the cost of poor quality through warranty, scrap and rework probably leads in these. Another is the doctrine of "make it right the first time" with its corollary requirement that faulty components be discovered and eliminated from the manufacturing system on a timely basis. A third is the growing sophistication with respect to significant product parameters and the development of detection devices to measure such parameters.

Automaticity a Leading Quality Contributor. With the drive on throughout industry to improve productivity, much of the manufacturing planner's work in many companies is concentrated on automatic processes that will eliminate or reduce the human element in parts processing, parts handling, and parts assembling operations. Automatic parts qualification and inspection have become, perforce, integral aspects of the planner's overall task.

The manufacturing engineer, the product design engineer, and the quality assurance engineer are team-planning for the required output at the required quality level. Typically, the manufacturing engineer has responsibility for suitable manufacturing equipment; the quality control man is responsible for specifications of the inspection/measurement/test equipment. With greater integration of processing equipment into manufacturing systems, the roles of the manufacturing and quality engineers begin overlapping, and the automatic equipment they're specifying often shows this.

In transfer machines, drilling and tapping spindles are interspersed with inspection probes, and automatic hole gaging spin-

dles direct boring tools to compensate for wear. In grinding machines, parts gaging devices control wheel feed mechanisms. In automatic assembly machines, quality verification begins with parts qualification, continues through the assembly sequences with probes ascertaining proper part presence and orientation, and, finally, ends with functional testing of the whole mechanism.

"There's no question," says Howard Dvorak, department chief, Hawthorne Works, Western Electric Co., Inc., "that we're being pushed in the direction of automatic machines for many of the product lines we manufacture. And inspection facilities are a good example of the trend we're seeing. We have high volumes with relatively small parts. And we can justify the costs involved with such setups."

"We are not interested in whether a piece is junk after we produce it," explains Charles Eberhardt, manufacturing manager of Caterpillar Tractor Co.'s Aurora, Ill., plant. "We're interested only in producing good pieces, and we want to have integrated checks right at our machines so that we know what we produce is good. We need to go further in this direction."

"We are involved very deeply today in an automatic testing program that is, from a capital investment standpoint, just tremendous," adds Richard Huber, general manager of Admiral Corp.'s Harvard, Ill., operations.

"Our corporation committed itself about eight months ago to this program, and we are extremely enthusiastic about it.

"In circuit board testing, we now can take a girl off the street and after about three hours of training she can operate a machine which punches out a tape telling exactly the condition of the board, what parts if any are faulty, and the electrical values of the components.

"This is a go, no-go gate or system. While it represents a large capital expenditure, it also has greatly reduced our training requirements and provided a tremendous improvement in quality."

Howard Dvorak
Western Electric Co., Inc.

"In relation to automation which bears on the testing and quality control subject, we have several projects going on now to develop equipment where we inspect our material while it is in process. The idea, of course, is to correct any defects early in the system." E. F. Stebbins, vp-operations, Iron & Steel Division, Interlake, Inc., is describing the qc approach in his steelmaking operations, but his remarks also are pertinent to every industry's emphasis on sophistication in testing equipment, and they also illustrate his customers' tightening demands for quality.

"At our Newport, Ky., plant, we're doing something that's never been done before: We're coming up with an automatic gage control on our hot strip mill, utilizing x-ray equipment interfaced with the mill rolls' hydraulic system. Automatic gage control is, of course, probably the only way a mill can meet its customers' tolerances, which used to be zero plus or minus eight thousandths and now are something like minus zero and plus four," he explains.

Richard Huber
Admiral Corp.

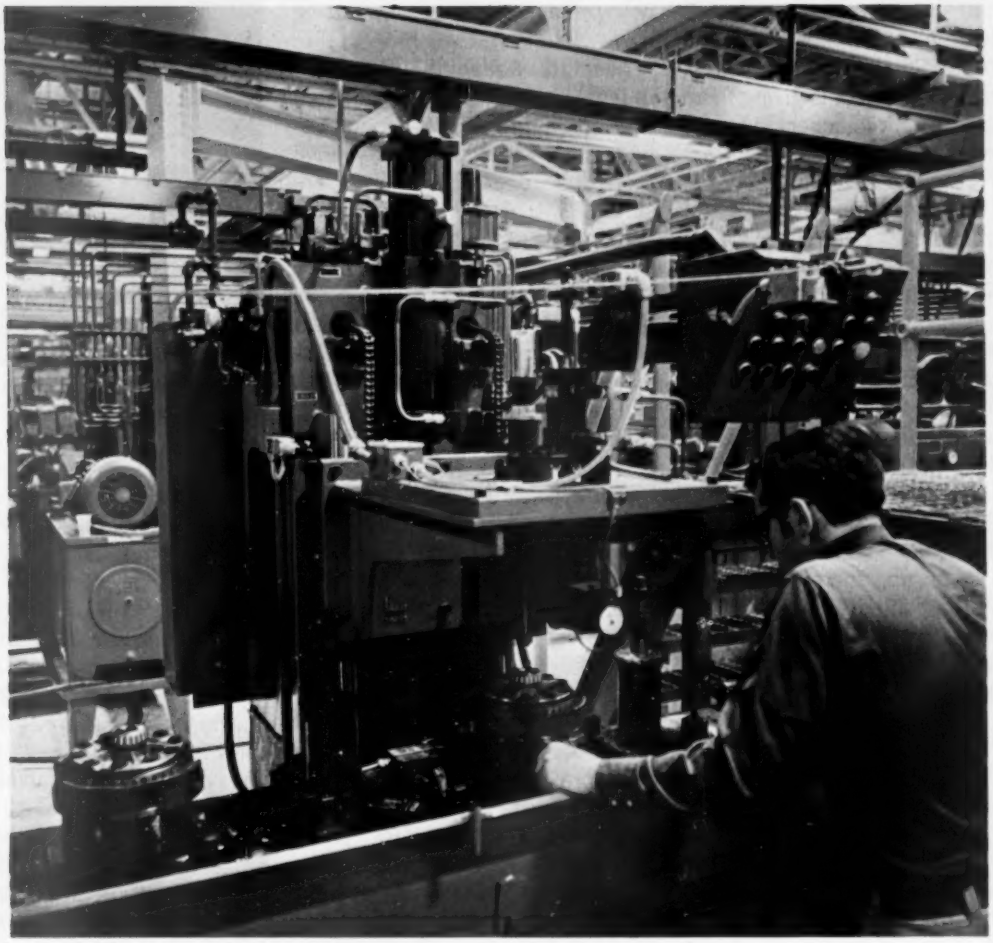
Testing and gaging equipment suppliers to the metalworking industries concur that automation and greater automaticity in many operations are significantly influencing their products and their early involvement in manufacturing system design.

Federal Products Corp. claims that "while automatic gaging is not the only way to more profitable production, it is certainly underexploited and the most promising." Magnaflux Corp. says: "The automotive industry, for example, is now voicing the very real need for further automating all facets of in-process production, including in-process mechanized quality control systems." The goal, Magnaflux adds, is "to increase inspection effectiveness and reduce over-all production costs."

Strong demand for automatic gaging in the farm equipment and appliance industries, particularly, and in many other industries is noted by Bendix Corp's Automation & Measurement Division. Its director of marketing, Louis C. Reichbauer, reports that for the moment, at least, and because of the energy problem and its attendant shift of emphasis to smaller cars the automotive industry has been forced into a "wait-and-see" period. Most of the other industries are "going great guns," he says.

Equipping new facilities is a particularly important part of the strength of demand from the farm equipment producers.

The Person's Role. Despite the importance of the automation trend and the impressiveness of the equipment that it has spurred, the majority of metalworking's manufacturing and gaging and



Gaging and inspection has become an integral part of most transfer machines and automatic assembly machines, as in this Buick rear axle differential assembly system's station where the ring gear's runout is being checked. Even where machining operations are not so highly integrated, automatic equipment for 100 percent inspection in preference to checking by the sampling process is becoming dominant. And because of product safety considerations, thorough quality documentation for many products is being required.

testing operations still relies heavily on people.

Are they competent and motivated enough to produce quality parts is the question a manufacturing planner must determine in mapping out the way he'll develop an improvement in his operations.

He'll get much argument in a group of manufacturing managers over whether the average production operator can be trusted with the responsibility for quality. Says an office machine producer: "We try to provide each operation on a part with a functional gage, where the operator doesn't have to have taken a course in trigonometry to interpret what he is making; but it becomes a problem of making sure he's putting the part in the gage all the time, instead of worrying about making the rates and knocking the parts out. Is he using the gage and if something looks fishy will he open up and say something about it? Unfortunately, on more than a few occasions we'll find the people running the job irrespective of what the gage says so they can make the rates."

Yet, in this connection, C. D. Seidler, manager, new products planning, Teletype Corp., philosophizes: "By and large, I feel that most of the people you have working for you want to do a good job if they know what the job is. They need to be fully aware of and instructed properly on what the job requires."

A key to the job enrichment programs that now are being tried in widely scattered companies is basic belief that people do want to do a good job. The philosophy is that most people will work better and will get greater satisfac-

tion out of their jobs if they are given greater responsibility and are trusted to a greater degree. An important aspect is giving them the opportunity for checking their own work and correcting the product if possible.

L. Paul Williams, manager of manufacturing, Controls Division, Eaton Corp., says that the testing operations in the products where his organization is using job enrichment have been changed "remarkably." On controls for dishwashers, for example, which formerly were assembled on a progressive line and tested at the end of the line, the assembly and test work now is given to one person. "We have found that quality levels have gone up, merchandise returns have gone down, and our rework has dropped." On other products where there are a large number of important quality parameters and functional testing is done after subassemblies have been made by individual workers, the number of rejects "automatically drops," Williams says, adding: "We have yet to see an operation where this doesn't happen."

This approach, he says, will not apply to all products; some are too complex. "It now is used either where we have a well-identified, functional subassembly or a well-identified finished product without a great deal of complexity in it. The product must be something simple enough that the normal individual can handle it, and fortunately many of our operations fit into that category. We're not using this approach in our electronic products where there is is greater complexity," he explains.

Some makers of hand gages are not able to detect job enrichment as an important new factor in their overall very heavy demand. Carl O. Newton, sales vp, L. S. Starrett Co., for example, says that "all industries seem to be trying to increase their facilities, their capacities." His company's problem with respect to meeting the over-all demand is caused primarily by long leadtimes in getting new machines.

Absolute Reliability with Documentation. It has been estimated that the number of product liability suits will double this year to more than one million, and Consultant C. L. Carter, Jr., declares: "We have a serious product-liability crisis in this country today."

The areas of management risk most likely to cause damage to a company are, in his opinion, quality, reliability, safety, and service.

The consumerism movement, which was to many companies at first only a nuisance and primarily a problem for the public relations or customer service departments, has grown far beyond that in its impact. The new federal law with respect to safety creating a Product Safety Commission will have somewhat the same effect on companies whose products are cited as OSHA has had on all companies. Quality will have to be planned more carefully, produced without deviation, and documented precisely. OSHA-related products already have had their quality requirements tightened, and Magnaflux Corp., for one, notes there's been "a general awakening of industry to the low-cost avenues of utilizing nondestructive testing to prove quality in the face of consumerism and OSHA.

"The very real threat of product liability problems is strongly involved here," the company explains. Defect finding in crane hooks, rolling stock, and all handling devices has given a boost to magnetic particle inspection, ultrasonic portable equipment, and testing services.

Julius Vetter, president, Louis Allis Co., reports: "We keep a record of all test procedures and test results of all motors we produce. Depending on the categories of motors, the elaborateness of the tests and of the record varies. But we now must be much more careful about this documentation."

W. J. Shane, director of manufacturing, West Bend Co., points up the uncertainties his and other

C. D. Seidler
Teletype Corp.

companies making small electrical appliances, for example, are facing until the hazardous product list is fully developed.

"We make a cornpopper and put it under warranty. But at this point, there is no serial number, no record. We are hearing that maybe we will have to serialize each of these hundreds of thousands of cornpoppers and keep records on them.

"We're not sure of the testing procedure we'll have to go through yet. This will be a wide open field for some new work for the testing equipment and record retention people."

Where the volumes are in this magnitude, this says "automatic equipment" loud and clear to a manufacturing planner, and probably also says "computer."

Such equipment in large variety, of course, is presently available, and Federal Products Corp., which has built more than 1000 automatic gaging machines, says electronic systems for gaging are fast becoming the dominant type.

For testing and inspection of electrical/electronic products, however, there's a strong tendency for users to build their own systems, and this creates an internal need for highly skilled electronics technicians, which are in very short supply.

Teletype Corp.'s C. D. Seidler outlines the situation: "Testing and measurement are something we are deeply interested in, espe-

Robert Sparkes
Victor Comptometer Co.

cially in the electronics area, and it does pose severe problems.

"Whatever you design has certain performance characteristics and other criteria that it must meet with respect to temperature, humidity, etc. And everyone in the electronics field knows that the exotic new electronic components are initially very temperamental. How do you adequately test these things?

"It usually winds up that the testing equipment is special for your application. You can buy a standard piece of gear, but it doesn't quite do the test job that you want it to do. The test engineer will always say: 'I've got to have a computer.' So he gets his computer and sets it up and programs it for the test.

"Well, we've all been bit one way or another on some of the computer and software problems. It always takes a heck of a lot of time—much more than the person originally forecasted it would."

Another man whose company now is becoming deeply immersed in electronic component testing is Robert Sparkes, vp-manufacturing, Victor Comptometer Co. "Whereas before, we made a large portion of our product in-house when we were producing electro-mechanical machines, we now are buying a large portion outside. And this means we have to have new ways of testing," he says.

"And the problem of specialty testing is that we have to develop the equipment ourselves. You can't buy a package off the shelf to test products that are unique to your own operation. We buy basic equipment, and then put it together ourselves."

Admiral Corp.'s Richard Huber says this also is S.O.P. with them: "We have a constant up-dating program in our plant with respect to testing and inspection equipment, and we develop most of the equipment ourselves. Everyone's facilities have their own special problems and limitations, and we couldn't use the same equipment that someone else might be using. We prefer to do it in-house."

Carl Insel, director of manufacturing, Communications Division, Motorola, Inc., reports that their circuit board and semiconductor testing operations are automatic and computerized. "In the manufacturing operation, we also have a computerized setup for testing of the thick film modules the company produces. We want to make sure they're good before we put them into the circuitry because they are difficult to remove once they're in place," he explains.

The Japanese, many manufacturers claim, are advanced beyond many American companies in their use of automatic inspection/testing equipment in part because of the newness of their facilities. And because of the 100 percent inspection such devices provide, each of their products is more likely to meet total specifications than products given statistical checks or tested for total performance only in the prototype or on a samoling basis. One hundred percent testing is felt by many companies to be the only way to go as quickly as process changes that will accommodate it can be made.

CMMs Gain in Popularity. In coordinate measuring machines, often used in conjunction with numerically controlled equipment, Bendix-Sheffield's Reichbauer says there's a growing demand arising from small shops. His company last year acquired rights to the Portage line of CMMs, which are complementary to the popular Bendix Cordax machines, and demand is across-the-board as companies strive to upgrade their inspection capabilities at the same time they're developing greater accuracies in their machining capabilities.

Falk Corp.'s general works manager, Henry M. Knauth, for example, indicates that his shop will be expanding its inspection equipment at the same time as its manufacturing machines. Presently capable of manufacturing gears up to 40-ft diameter, Falk uses a Portage CMM with printed readout, purchase of additional equipment of this type is in the planning stage.

Automaticity Opens New Assembly Approach. An intriguing new possibility for improved product quality that automatic measurment and gaging opens up is selectively matching components. Not new to engine manufacturers for such things as cylinder bores and pistons, shims and other spacers, selective fitting may, however, relieve some of the high-precision machining requirements of other products since mating surfaces can easily be classified and an even more precise fit obtained than feasible now.

Potential importance of this "new" approach is suggested by the automakers' admission that occasionally production-line engines now can meet some of the more stringent future emission control requirements by the confluence accidentally of precisely mating parts.

Metrication's Influence. An important new factor in a manufacturing planner's considerations in the area of gaging/measurement/testing is his company's metrication plans.

It is apparent that American industry is moving rather rapidly toward adoption of the metric system and will quicken the pace this year, regardless of congressional action. For many larger compa-

continued on page 120

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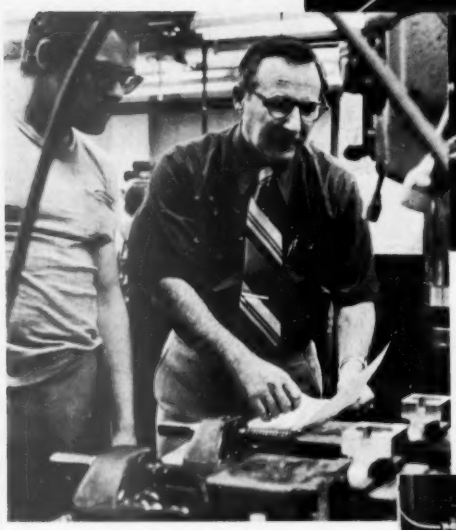

AUTOMOTIVE MARKET COVERAGE Ed Chapman . . . manager of Federal's design and manufacturing facilities for the metalworking Midwest. Ed and his people are expert in producing high precision, extra rugged automatic gages and transfer line gaging like those required by the automotive industry. Federal Midwest, number one gage manufacturer in the Detroit area, brings more than 20 years of experience to automatic gaging problems.

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CREATIVE ENGINEERING Frank Savicki (left) . . . creative designer and electronics expert with an enviable record of great gaging ideas. His know-how has helped manufacturers protect precision and profits on products ranging from pistons to golf balls. Chances are, he and his 30 men have already solved your problem . . . and refined the original solution in the bargain!

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continued from page 117

nies, mostly those with substantial overseas manufacturing operations and/or overseas sales, last year was the "decision year." Implementation is just beginning, and generally on products of new design.

Gage makers see a sharp upswing in demand for metric products, which will intensify; what's now a trickle will become a flood.

Many of the ultra-sophisticated programmable gaging devices can be converted to metric measurement by simple adjustment or the flick of a switch, but simpler gages will be replaced with metric-reading instruments as needed.

Bendix-Sheffield's Reichbauer says about 50 percent of his company's coordinate measuring machines with digital readouts are being ordered with the metric readout option. There's substantially less demand for metric-reading instruments than that percentage, however, in the hand-gage area and the small inspection devices made by L. S. Starrett Co. "A very small percentage of our production currently is for metric products," says its sales vp, Carl Newton.

Several end-product manufacturers are avoiding the problem of dual-dimensioning drawings and dual-reading instruments by segregating their metric product manufacturing operations as much as they can from their inch-based products. The possibilities of operator error, they feel, is greatly reduced by this approach.

Caterpillar Tractor Co., which was one of the first domestic companies to heavily commit itself to metric units for all new product designs and drawings, also intends to manufacture its new parts to the metric units using metric gages.

As a part of its conversion plan, it developed a computer program that converts metric units to their U.S. customary equivalents. This program's printout then is attached to each product drawing. Its purpose is primarily administrative—to aid stock control, tool selection, etc.—but initially it also provides a double-check against dimensioning errors.

This computer program is being made available for other manufacturers by Caterpillar, with distribution beginning early this year to be handled by the National Bureau of Standards at a price not yet set but expected to be in the neighborhood of $500. NBS, meanwhile, is trying to obtain another computer program converting customary units to metric units. Such a program then might be offered with the Caterpillar package.

There's little published material yet giving manufacturing planners a guide for their own companies' metric conversion. But one of the most comprehensive pilot programs that's being conducted is, fortunately, one that will be made public in great detail. The Lawrence Livermore Laboratory has for a year been engaged in a pilot metric changeover, involving in-house manufacture of a variety of metric design parts and the contracting outside of others.

The program is a "cold-turkey" approach, avoiding dual-dimensioning. However, the machine tools are not being converted until they're due for replacement. Only inspection devices are converted because their cyclical replacement would be too slow to permit the orderly and timely metric conversion.

Integrated contractors for the Atomic Energy Commission have adopted the Livermore Plan as their model, and more details of it can be obtained from Metric Project Officer, Lawrence Livermore Laboratory, P.O. Box 808 L-123, Livermore, Calif. 94550. ■

useful literature

A collection of material on GE's Neutrography service, a visual nondestructive technique now available for internal inspection of components and structures, is contained in a handy file folder. (General Electric Co.) *Indicate No. 631 on card*

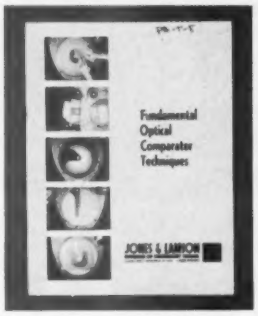
Two application notes, one 8-pages and the other 24-pages, show how to use laser interferometers in the machine shop, metrology lab, and quality assurance department. (Hewlett-Packard) *Indicate No. 632 on card*

"Go Millionths . . . Go" is a 94-page guide to measuring instruments, gages, and gaging accessories. (Alina Corp.) *Indicate No. 633 on card*

Force and weight measuring instruments for straight line productivity are described in a 12-page brochure. (Martin Decker Co.) *Indicate No. 634 on card.* **Crane scale** applications unlimited are described in a 4-page brochure. *Indicate No. 635 on card.* **Load cell** applica-

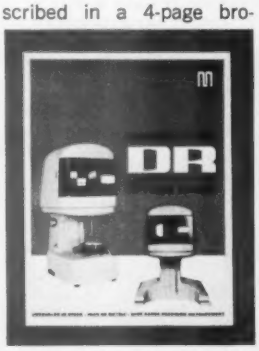
tions unlimited are described in a 12-page brochure. *Indicate No. 636 on card.* **Weigh it as you lift it** is the subject of a 4-page brochure. *Indicate No. 637 on card*

Fundamental optical comparator techniques are described in a 42-page bro-



chure. (Jones & Lamson). *Indicate No. 638 on card.* **Why you should use a J&L comparator** for presetting tools is presented in a 10-page brochure. (Jones & Lamson) *Indicate No. 639 on card*

Direct reading optical gages, in inch or metric, are described in a 4-page bro-



chure. (Bausch & Lomb). *Indicate No. 640 on card.* **A linear digital incremental measuring** system is described in a 4-page brochure. *Indicate No. 641 on card.* **A variety of precision measuring instruments** and scales are described in a 4-page brochure. *Indicate No. 642 on card.* **Precision rules** and scales are described in a 4-page brochure. *Indicate No. 643 on card.* **Master scales and grids,** ruled on an NC machine with one microinch resolution, are described in a 4-page brochure. *Indicate No. 644 on card*

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Leak test stands, carburetor test stands, and other engine testing equipment are described in a literature package. (Scans Associates, Inc.)
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Dynamic analysis as a means for tracing and reducing vibration and noise is described in a 14-p. brochure. (Spectral Dynamics Corp.)
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The Del-Con line of electronic test, control, and monitoring equipment is described in a literature packet. (Delco Electronics Division, General Motors Corp.)
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Basic primer on conversion to the metric system, with special emphasis on how to read metric tools is offered by Brown & Sharpe Manufacturing Co.
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Guide to surface measurement and surface texture is provided in Gould Inc.'s Measurement Systems Division 16-p. booklet.
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A wide variety of optical and electronic measuring instruments is described in a 20-p. booklet from Ehrenreich Photo-Optical Industries, Inc.
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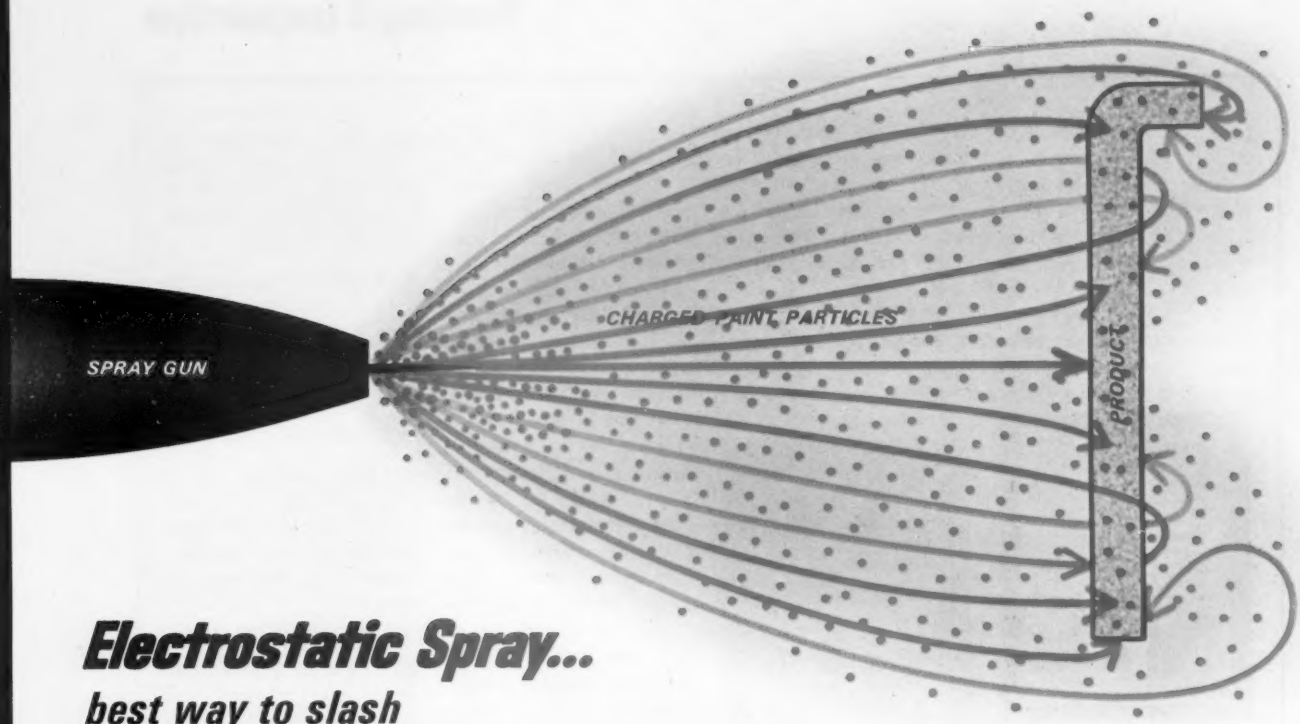

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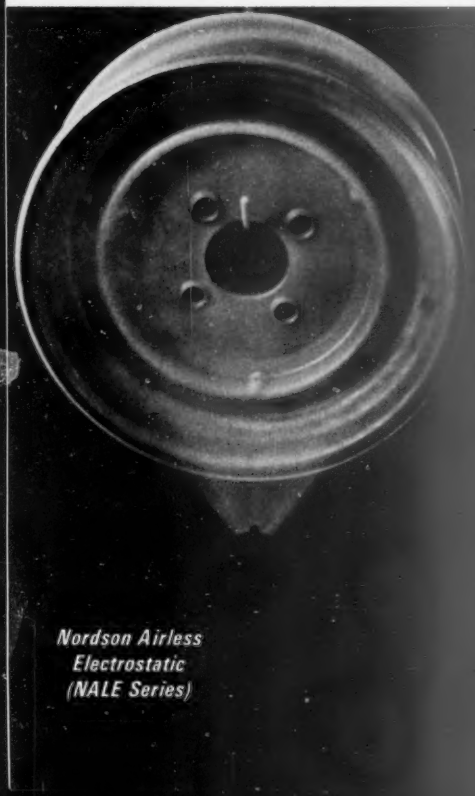

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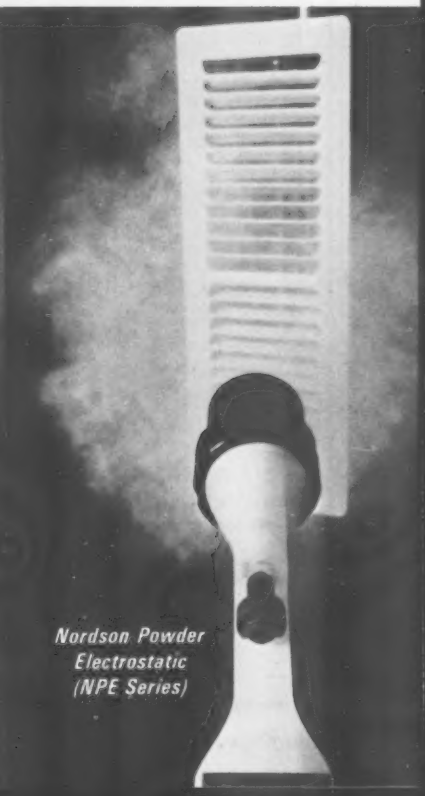

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Emission Avoidance Sought in Painting, Cleaning, Plating

Painting is the most common, and most economical, production finishing process. Plating is the other principal finishing method. And cleaning is essential to both. Users are having difficulties in all three areas, and the PLANBOOK cites some of these difficulties, some approaches being taken, and some vendor recommendations.

PAINTING

Today, electrostatic spray painting is being widely used; however, numerous operations are utilizing the air pressure spraying systems. Both systems have definite values in terms of finishing, and the selection of a process is determined primarily by the parts' configuration. The air pressure method provides maximum flexibility and capability for a wide array of parts. Electrostatic spray painting features include consistent and uniform paint film with less overspray and subsequently less material loss.

Modern production painting systems are highly sophisticated automatic operations. Parts to be painted are hung on a moving monorail conveyor, transporting them through a paint spray booth and a drying or curing oven to an unload area. Such painting systems usually perform the operations without manual intervention when properly "tuned."

However, numerous influencing factors involving personnel and allied equipment create several common problems in connection with paint finishing systems. An expert, Joseph E. Ziegeweid, industrial training manager at Graco, Inc., highlights these problems as a way of helping manufacturing engineers alleviate them in their future planning.

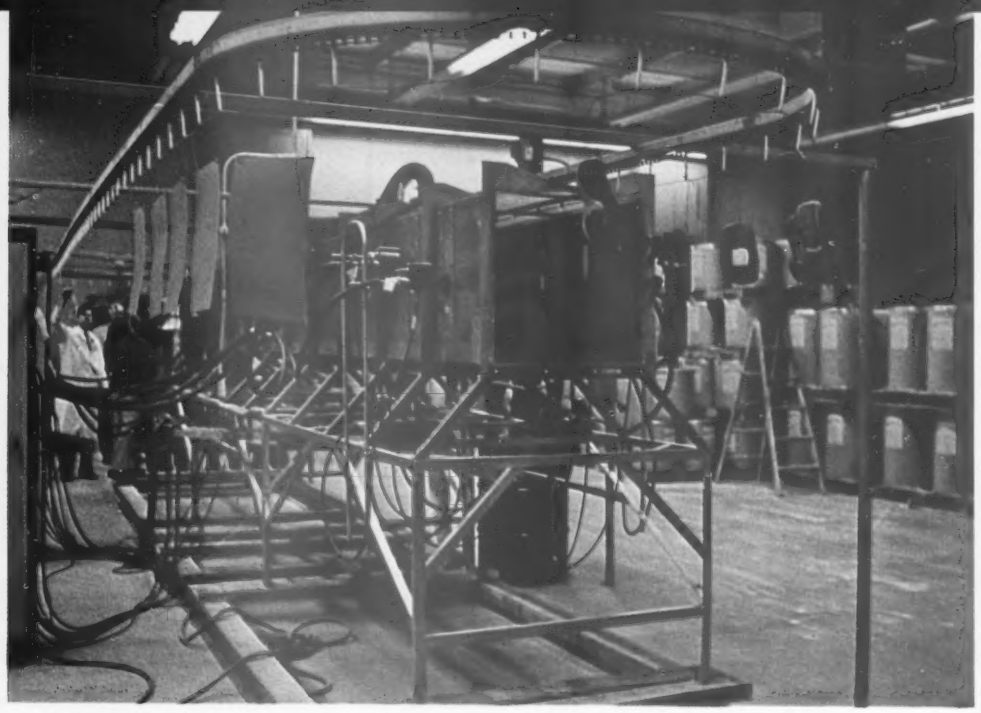
Most production painting problems fall into five primary categories: commercial considerations, environmental conditions, finish, equipment, and personnel.

Commercial considerations involve the equipment builder, paint supplier, and user. They include concentration on buying and selling—but not at the expense of "using." Better coordination between all factions is needed. One solution is for equipment builders and paint suppliers to jointly acquaint a user's production line personnel with exactly how the total package is expected to operate in the manufacturing plant environment.

Environmental conditions represent an area where quite often a lack of coherence exists within a production plant. Failure to consider the total balance needed for an efficient production painting system is the primary difficulty. Consideration of the supply within a plant is an excellent example. In some operations, excessive air is exhausted from one area of the building while an overworked makeup system in another area can't possibly meet the demands. Additional in-plant environmental problems include vapor degreasers contaminating the atmosphere in the area of baking or curing ovens; lack of preventive maintenance that allows painting equipment to operate until it breaks down; inadvertent adjustment or changing of oven temperatures to accommodate a new product without regard to an existing product being processed; no attention to ancient and dirty lighting fixtures used with or near a new, expensive automatic painting system.

Finish sometimes is an area where the penny-wise and pound-foolish approach is taken. Use of low quality painting materials to reduce costs usually provides an equally poor quality finish. Substandard paint normally contains inadequately ground pigments which tend to clog spray nozzles and excessive thinner which contributes to sags, runs, inadequate coverage, and drying problems.

Equipment can present a serious problem in painting because a wrong tool simply can't perform a good job. Additionally, the wrong type of painting process seriously impairs the economics of a finishing operation: A system incapable of handling the volume of large-size parts cannot produce consistently high quality finished parts.



An electrogasdymanic tunnel powder coating system at the Sherwin-Williams plant in Pontiac, Ill., is claimed to virtually eliminate overspray. The eight-gun system features 97 percent deposition efficiency and no cross-contamination when alternate colors are being sprayed

Excessive air drafts in the water curtain seriously effect the spray nozzle pattern; drafty curing ovens with widely varying temperatures produce poor quality finishes. Dirty conveyor hooks on electrostatic systems provide weak electrical connections which contribute to unpredictable quality.

Personnel problems usually revolve around lack of training and experience. Operators often are assigned to oversee a highly sophisticated painting system without being taught why or how the system operates. Adding to the personnel problem is the high turnover rate, and hard-learned experience is lost when an employee moves or is transferred to another job assignment.

Commenting further on problem avoidance, a DeVilbiss spokesman adds: "Strong knowledgeable production line supervision is one solution to numerous painting problems. Operations with well-trained operators capable of handling a spray gun with proper triggering coupled with an understanding of fluid viscosities and temperatures invariably experience few problems. Such operations also produce consistent, high-quality painted parts.

"Good housekeeping, including maintenance, is another productivity asset. Ultra-clean surroundings, properly cleaned parts, elimination of air-borne dust, and operators with clean clothing help avoid blemishes on the finish painted parts."

Users Speaking. Despite its widespread and long-term use, painting still is causing many companies severe problems. To some degree, the problems can be attributed to rapid growth within a company. Some have outgrown the economic usefulness of their finishing systems, but are hesitant to make the investment required for a new system.

The problem with a system that lacks flexibility is told by Louis Allis Co.'s president, Julius Vetter: "One of our painting operations consists of rust-proofing about 200 different varieties of castings. They range from about 1½ in. in diameter to nearly 48 in. in diameter and up to 48 in. long. Adding to the variety, some castings contain fancy contoured cores, others have holes, and a few versions are flat.

"Each casting is rust-proofed when received from the foundry because they are stored outside for up to six months. Our manually operated paint spray method is not efficient, or economical in my opinion, but it is the best system available for the job. Several alternate methods have been attempted, including dipping, flow coating, and electrostatic, but none performed to our satisfaction. Our problem concerns the wide product mix of castings, and we are looking for a beter method of rust-proofing."

A major appliance manufacturer is looking to the equipment builders and materials suppliers for help in improving porcelain finishing operations. "Whirlpool Corp. is extremely conscious of finishes," says Donald Lorton, corporate director of facilities planning. "Household appliances such as laundry equipment operate in a very hostile environment such as bleaches, detergents, etc., which necessitate a high quality and durable finish.

"We are investigating improvements in the porcelain finishing area. If possible, lowering the porcelain firing temperature from the present 1400 to about 600 degrees could make a significant contribution to the energy crisis. I think both the eqiupment build-

ers and porcelain suppliers can help us in this venture."

Importance of Cleaning Stressed. Basically, preparatory cleaning operations are vital to the quality of either a painted or plated finish. Surface finish imperfections often can be traced to inferior cleaning operations. Another major appliance manufacturer is experiencing such a problem.

Larry Levine, manager of manufacturing engineering at Hotpoint Division of General Electric Co., reports: "My most difficult problem is cleaning welded components; unclean parts cause scrap

Larry Levine
Hotpoint Co.

which is not detectable until after finishing.

"The primary problem involves appliance main panels to which are welded brackets, gussets, etc. They then are processed through cleaning and enameling operations and fired at 1500 degrees. Oil, grease, or weld flux results in black spots after baking the enamel—this represents scrap parts.

"I think improved monitoring for the phosphate cleaning systems would help alleviate our problem. Understandably, temperatures of pickling solutions and chemical balances are vitally important to good cleaning. However, the system gets out of balance during production surges when more tonnage of material than normal is processed. Obviously, the baths and solutions should be modified to accept these conditions. I think the systems' controls could be improved and a monitoring system added to warn when critical elements begin to creep from normal."

Cleaning and deburring is a vital concern with another manufacturer. Jerome J. Kriva, vp-manufacturing, Hydraulic Components Division, Rexnord Corp., says: "The entire field of cleaning and finishing of production parts is one big problem. Despite the technological advancements there are numerous companies today employing people with dental picks removing burrs.

"Cleaning and deburring is one of our inherent problems in the manufacture of hydraulic components. These parts must approach surgical cleanliness to provide high quality reliable hydraulic operation. Our problems concern chips buried in castings, burrs, imbedded grit, etc., and the rust-proofing of these components.

"Ultrasonic cleaning is among the processes being investigated. However, an ultrasonic system capable of handling our large variety of parts represents a substantial capital investment. We are hoping to discover an economical and practical method of cleaning and finishing.

"We are making some progress in the deburring area with a new Extrude Hone machine to deburr hydraulic valve spools. These parts contain several drilled and cross-drilled holes with difficult-to-remove burrs. And, these burrs must be removed. The Extrude Hone, or abrasive media, process appears to offer a solution. Experiments are in process to discover the most efficient method of injecting and removing the abrasive material. We're close, but not entirely satisfied with our method.

Jerome J. Kriva
Rexnord Corp.

"Painting is another problem area. I think we—all manufacturers—should evaluate our finishing methods more carefully. In far too many cases, parts or products are finished by painting on a whim, or because a similar product was painted, not because it is the best process for the product. And, let's not forget that new production painting systems with built-in flexibility and modifications to comply with OSHA represent a considerable investment.

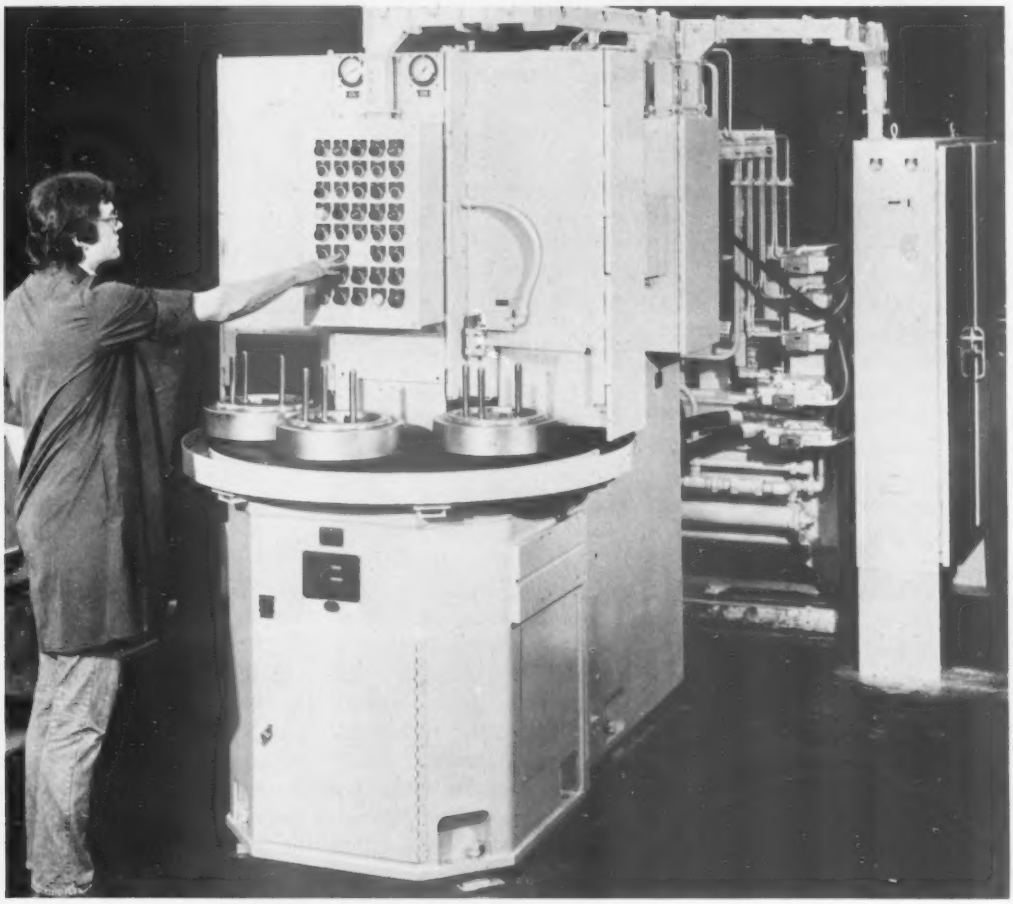
"But, how often do we ask ourselves: 'Does the customer really want or care if the product is painted?' Maybe precoated material could have been used; perhaps the product could have been dip coated; maybe fluidized bed coated with plastic, etc.

"The point is, we are so preoccupied trying to meet production schedules and trying to obtain new equipment to conform with state and federal regulations that we don't honestly know exactly what our customers want or what they will accept."

POWDER COATING

Recent technological developments have made the electrostatic powder coating finishing process a competitor of wet paint spraying. Although powder coating has been used for some time previously in Europe, it was introduced in the U.S. about 1956. The process today is making significant in-roads and is finding application in most industries.

The automotive industry, of course, represents the largest potential for powder coating. And both domestic and foreign automakers are investigating the pros and cons of powder coating. At its Sagama plant, Honda Motor Co. Ltd. of Japan is in production of its new Civic model car painted



Deburring with a flash is accomplished in this Surftran machine utilizing the Thermal Energy method. A controlled gas mixture of hydrogen and oxygen under pressure flash-ignites and burns at 6000 degrees, oxidizing the most difficult to remove burrs

by the world's first powder coating process for entire motor car bodies. The system was engineered and built by DeVilbiss Co. Honda officials term the installation a landmark in emission-free car painting. In the U.S., a General Motors Corp. pilot facility at Framingham, Mass., and Ford Motor Co.'s Metuchen, N.J., operation are conducting extensive production tests. The two operations, in total, have powder coated thousands of autos, and say a superior auto finish is being produced.

Powder coating offers numerous advantages over wet paint spraying. The most important is environmental control. The 100 percent power compounds do not contaminate the atmosphere with solvents or volatile vapors. A significant reduction in maintenance, labor, material handling, and rejects also are among the prime benefits.

Power coating provides a surface finish equal to or better than wet paint spray. Consistent films can be applied as thin as .5 mils with a superior coverage in wrap-around areas and on edges.

Multiple-color finishing, however, presents one of the major difficulties with powder coating. Color changing also affects the economy. About 96 percent of the overspray can be recovered and reused when a single color is applied. However, color changes preclude the use of reclaimed powder except for a prime or undercoat.

The Users. One manufacturer who converted to electrostatic powder coating improved its productivity 100 percent. A recently installed fully automatic DeVilbiss electrostatic powder coating system at the Fire Protection Division of Ansul Co. is finishing outer shells for hand fire extinguishers. In addition to the productivity improvement, the powder coating affords a 300 percent better resistance to salt spray.

Among users investigating the process is Caterpillar Tractor Co., whose manufacturing manager, Charles Eberhardt, reports: "Our research department is investigating both water base paints and powder coating. Caterpillar plants in Belgium and Viet Nam are using water base paints for finishing farm implements. We have sent engineers to visit those plants and observe the processes. An evaluation program is in progress to determine which is the best finish coat for our products."

Donald Lorton, corporate director of facilities planning at Whirl-

pool Corp., also reports interest in powder coating: "Whirlpool Corp. has conducted powder coating evaluation programs. One of our plants is about to begin using a powder coating system. We intend to obtain a superior surface finish and develop some basic production type information."

However, Larry Levine, manager-manufacturing engineering, Hotpoint Division of General Electric Co., takes a different stand on powder coating. "Powder coating is not a serious consideration in our business," he says. "We have investigated and evaluated the process, but do not anticipate its use in the near future. Our products require glass enamel finishes which provide good resistance to heat, food acids, etc. In our opinion, dry powder coating does not provide a finish complying with our specifications."

PLATING

Plating is a finishing process used primarly to provide a decorative or protective surface finish and sometimes both. Most production plating operations use the metal deposition process, which is capable of depositing or plating nearly any type of metal or alloy. However, chrome, copper, and nickel are the most common metals plated.

Usually, rack or barrel systems are used. Generally, smaller size uniform parts are better suited to barrel plating. Most plating systems are automatically actuated through an indexing mechanism controlled by a sequence timer. Parts to be plated progressively pass in and out a series of chemical cleaning solutions, electrically charged plating tanks, and pure water rinse baths.

Strong chemicals and acids are used in the cleaning solutions and some give off objectionable odors. Other chemicals such as cyanide are poison. OSHA regulations, which took effect in 1971, mandated numerous safety measures necessitating significant expenditures for plating operations. Other environmental requirements have compounded the problem.

A large number of smaller contract platers claim they can't comply with the OSHA regulations and plan to quit the business; several already have closed their shops. As a result, obtaining quality plating with reasonable delivery promises rank high among manufacturers' problems.

L. Paul Williams, manager-manufacturing, Controls Division of Eaton Corp., says: "The entire area of plating is a difficult problem in our operations. We produce a large number of stamped parts which require plating. The problem is locating a reliable contract plater. They are continually going out of business because of the OSHA regulations.

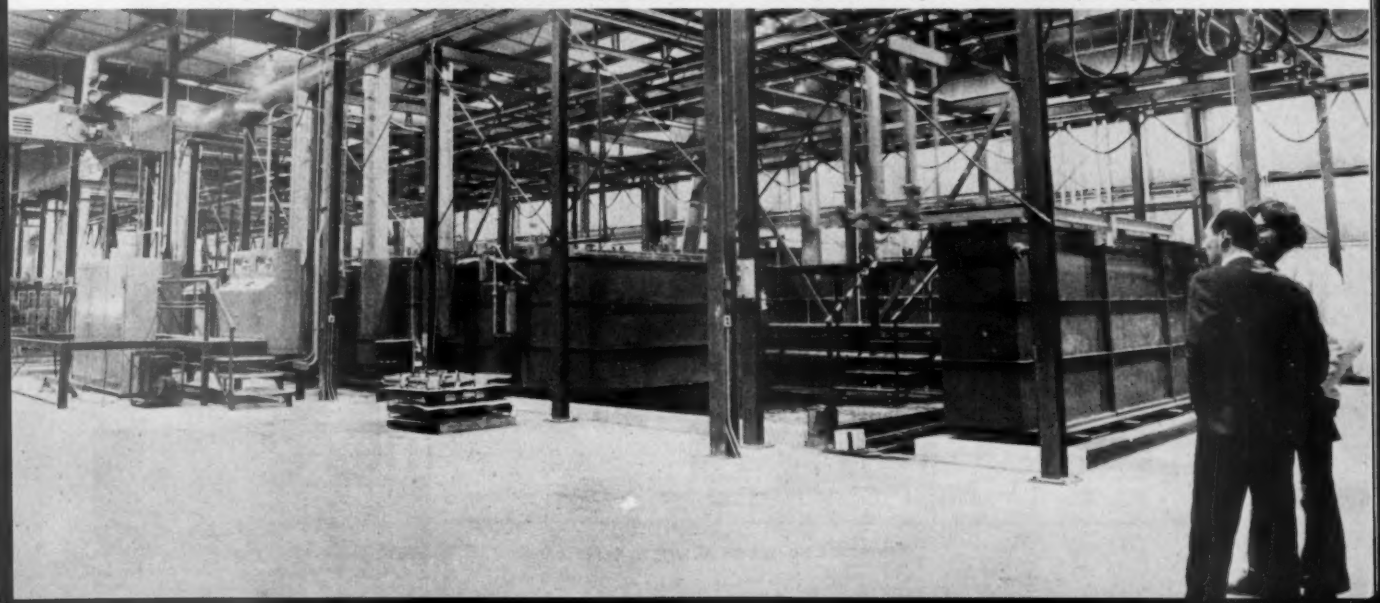
"We are not considering developing captive plating operations. However, other finishing methods are being evaluated. Galvanized metals offer some advantages as do some other precoated materials. The problem is not licked as yet, and the research is continuing."

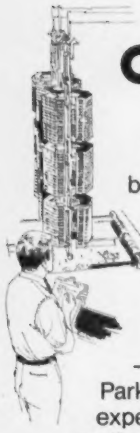
Builders of plating equipment and suppliers of material, of course, are aware of the OSHA problems and provide the best available technical advice. For example, Udylite Co.'s Richard Fellows, corporate director of OSHA, is deeply involved and has been instrumental in rewriting and obtaining a modification in the regulations to make the requirements more feasible in line with industry practices.

For companies planning to add plating operations, or those experiencing difficulties with existing equipment, the following tips are offered by another Udylite spokesman, Edwin Hoover, director of customer services:

Conduct comprehensive pilot studies to accurately determine the correct pre-plating cycle. The study should include cleaning and

A huge Udylite tape-controlled double hoist rack plater at Rogate Industries, Inc., plates over 57 million plastic parts annually for the auto industry. Similar size equipment is utilized only within captive automobile plating operations





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continued from page 127

acids plus the strike sequences; it also should cover proper rack design to provide good plate distribution as well as the most efficient production load;

Establish and maintain high quality base metal conditions. This includes high quality die castings with minimum internal stresses, minimum corners and recesses, etc.

Prepare and allow time for scheduled maintenance of chemical additions and tank electrical hook-ups, bus connections, anodes, etc. Filter and ventilation maintenance must also be included;

Provide sufficient storage facilities so the plating solutions can be pumped out frequently;

Include proper laboratory testing as well as analytical control of the solutions. More importantly, institute procedures so that lab recommendations can be followed;

Plan rigid quality control standards or accelerate testing to assure continual high quality plating;

Provide accurate control and monitoring of electrical power, particularly in decorative chrome plating operations.

Trouble-Shooting Plating. Assuming the plating equipment is in sound operating condition, good plating practices will normally assure a troublefree operation. A spokesman from M&T Chemicals, Inc., assisted in developing the following list of most common problems with nickel and chrome plating, and their probable causes.

Beginning with nickel plating; a *burning problem* may be caused by: too high cathode current density, improper racking, too low temperature, too low nickel concentration, too low boric acid concentration, insufficient anode-cathode distance, presence of organic impurities, too high pH.

Plating pitting causes include: too low anti-pit concentration, organic contamination, oil and grease contamination, colloidally suspended material, finely dispersed air aspirating through packing gland on filter or circulating pump.

Rough plate could be the result of: air-borne dirt, carbonaceous particles (torn anode bags), calcium sulfate precipitating, boric acid precipitating, silicon and silicates, buffing grit (carried into tank on the inside of work), filter aid material (torn filter bags or improper packing techniques), precipitating ferric hydroxide and aluminum hydroxide.

Inadequate leveling may be caused by: too low leveler concentration, too low pH, too low temperature, organic contamination, low nickel concentration, insufficient thickness.

Lack of normal brightness is caused by: too low brightener concentration, too low pH, too high temperature in presence of inorganic contamination, inorganic contamination, too low carrier concentration, poor cleaning, poor base metal preparation, poor copper undercoating, organic contamination.

Lack of normal ductility is often the result of: too high brightener concentration, too low carrier concentration, too low temperature, too low nickel content, presence of metallic impurities, organic contamination, too high current density, oxidation products due to anode polarization.

Poor coverage is caused by: poor cleaning, lead contamination, extremely high brightener concentration, zinc contamination.

In chrome coating, problems and their possible causes include:

Misplating or poor coverage (bright chrome): concentration too low, bath ratio too high or too low, insufficient current in chrome, build-up of nickel and chrome on racks, parts racked too close together, inadequate racks to carry current, improper anode to cathode spacing.

Burning (hard chrome): sharp points (excessive current), low temperature (below normal), catalyst and sulfate either above or below recommended limits, high metallic contamination, high chlorides, low or high chrome concentration.

Poor adhesion (hard chrome): deposition from a very high ratio bath, insufficient reverse etch time or too low reverse current. ■

useful literature

Sixteen case histories showing equipment and methods used in abrasive machining and final finishing of small tools are described in a package of 16 data sheets. (Acme Manufacturing Co.) *Indicate No. 600 on card.* **A series of eight case histories** explains methods and equipment for a variety of grinding, deburring, polishing, and buffing operations. *Indicate No. 601 on card*

A new process for the commercial applications of electroplated aluminum is described in a 4-page bulletin. (Ametek) *Indicate No. 602 on card*

Vibratory finishing and deburring, how to select the proper size machine, media, load size and a Roto-Finish Calculator, are included in Roto Tech Report #5 (Roto-Finish Co.) *Indicate No. 620 on card.* **How to modify** Spiratron vibra-

continued on page 131

Bring us your finishing problem . . . chances are we've already solved it!

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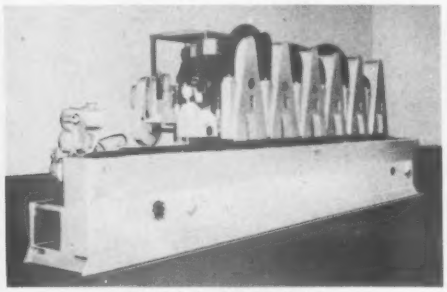
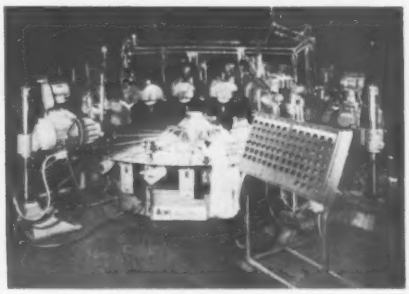
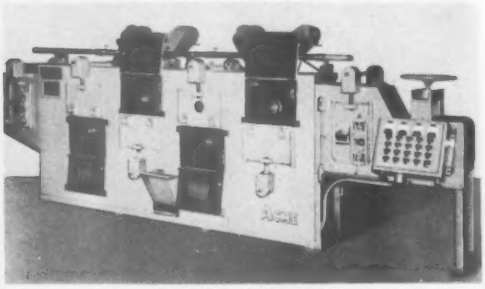


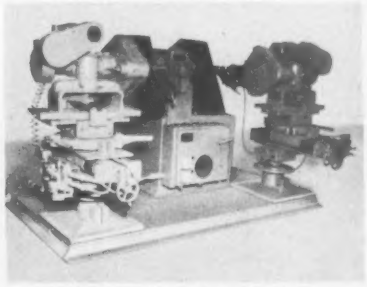
Multiple head flat polisher



Rotary automatic buffing machine

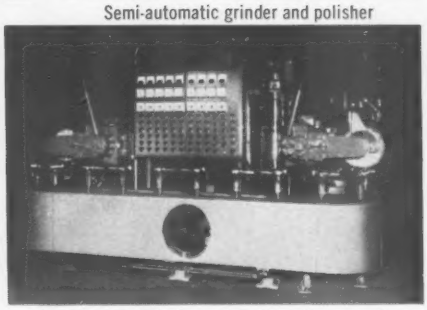


Brush-type strip washer



Semi-automatic grinder and polisher

Automatic vibratory finishing system



Universal straight line automatic buffing machine

ACME MANUFACTURING COMPANY

1400 East Nine Mile Road Detroit (Ferndale), Michigan 48220
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WORLD'S LEADING MANUFACTURER OF AUTOMATIC GRINDING, POLISHING, BUFFING, DEBURRING, WASHING AND VIBRATORY FINISHING MACHINES

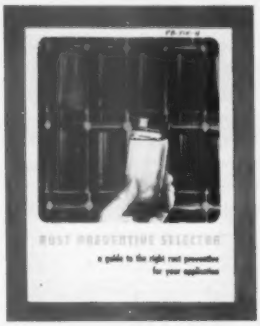
Affiliates: Acme-West, Inc., Los Angeles, Cal., C.C. Mitchell Co., Delta, Ohio, Acme-Murray Way International, Ltd., Detroit-London. Acme Maschinenfabrik GMbH, Neu-Isenburg, W. Germany, Campbell Machinery, Ltd., Kitchener, Ont., Can.

useful literature

continued from page 129

tory finishing machines to provide long cycles with "Rotomation" included in Roto Tech Report—Rotomation. *Indicate No. 621 on card*

A 6-page rust preventive selector provides a guide to selection of the right rust



preventive for given applications. (E. F. Houghton & Co.)
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A 12-page guide for selecting the right flame spray coating for different applica-

tions describes over 150 metallic and ceramic coatings. (Metco Inc.)
Indicate No. 604 on card

Criteria for selection of cleaning and finishing machinery, and examples of many types of machines, are presented in a 28-page bulletin. (Cincinnati Cleaning & Finishing Mach. Co.)

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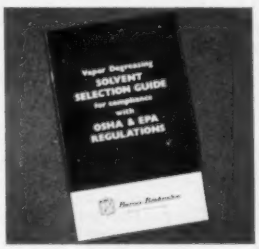
A 22-page vapor degreasing solvent guide describes the process and equipment, and



discusses OSHA requirements. (Baron-Blakeslee)
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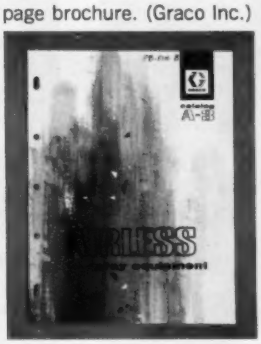
Airless paint spray equipment is discussed in a 16-page brochure. (Graco Inc.)



Indicate No. 607 on card. **Air spray painting equipment** is presented in a 16-page brochure. *Indicate No. 608 on card.* **Pneumatic and hydraulic equipment** for spray painting systems are described in a 52-page brochure. *Indicate No. 609 on card*

Metal cleaning fundamentals, materials, and methods are presented in a

20-page brochure. (Oakite Products, Inc.) *Indicate No. 610 on card.* **An 8-page power washing booklet** discusses effective approaches to spray-washer metal cleaning. *Indicate No. 611 on card*

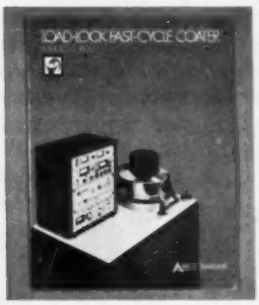
Five pieces of literature having to do with metal surface treatments are available from Sweco, Inc.: **Surface Treating and barrel** finishing equipment, an 18-

page brochure. *Indicate No. 612 on card.* **Automated Finishing** Centers. Seven pages. *Indicate No. 613 on card.* **Vibro-Energy finishing** mills, batch units. Four pages. *Indicate No. 614 on card.* **Vibro-Energy finishing mills** with semiautomatic internal separation. Four pages. *Indicate No. 615 on card.* **Automated jib systems** in which all major finishing functions, including media transfer, media/parts separation, etc., are automatically implemented, are described in a 4-page folder. (Sweco, Inc.) *Indicate No. 616 on card*

A 24-page air spray painting manual provides detailed information on the process

and operation of equipment. (Binks Manufacturing Co.) *Indicate No. 617 on card.* **A 20-page airless spray painting manual** describes the fundamentals, equipment, and advantages of the process. *Indicate No. 618 on card*

Vacuum deposition cycle coating explained and illus-



trated in a 12-page brochure. (Air Reduction Co., Inc.)
Indicate No. 619 on card

"Guidelines for Sonic Energy Cleaning" are given in Bendix Instrument & Life Support Division's 14-page manual that covers principles of operation, application, cleaning agents, soaking, rinsing and drying cycles. *Indicate No. 622 on card*

"The Art of Polishing" and "An Explanation of the Extrude Hone Process" are two booklets dealing with this new method of abrasive flow machining and polishing. (Extrude Hone Corp.) *Indicate No. 623 on card*

The Ingersoll-Rand Approach to Metal Finishing

HOW TO EVALUATE HIGH PERFORMANCE PORTABLE GRINDING FOR METAL CLEANUP

By Roger Hildreth
Senior Application Engineer

Will high performance portable grinding really help *you* to narrow the productivity gap—to get maximum efficiency from each man-tool unit?

This recently developed "Metal Removal Evaluation Work Sheet" is designed to provide the answers.

Developed by Ingersoll-Rand, the sheet allows users of conventional-speed portable grinders to compare their present method with performance of air-powered tools such as Ingersoll-Rand's Series 43FH vertical high performance grinder. It considers all variables involved while documenting on-the-job performance of the grinders: type of grinder, cost and number in use; abrasives; actual amount of time the grinders are used (studies by I-R indicate that this "use factor" averages 60 percent); work output; labor and overhead costs.

Tests we've conducted have confirmed that high-performance grinding allows an operator to actually remove more metal in a given period of time while expending less energy than required by conventional grinding.

For instance, our 43FH grinder removes up to 50 percent more metal in a given period of time than any conventional-speed grinder. The unit has a maximum of 4 hp at rated speed and weighs just 11½ lbs. At 8000 rpm, the 43FH with a 6" cup wheel produces an abrasive speed of 12,500 surface feet per minute. With a 9" depressed center wheel its rate soars to 19,000 sfm.

An exclusive "center shift" governor on the 43FH, and on all of our other high performance grinders, provides maximum horsepower at a higher working speed, allowing the wheel to turn faster and remove more metal.

A special overspeed device on all of these tools shuts off the grinders at 20 to 30 percent over governed speed in case the tool overspeeds due to abuse or maladjustments. In addition, special-thread arbors prevent accidental mounting of conventional grinding wheels that might disintegrate at the high speeds of the 43FH and other high performance tools. Added operator protection is provided by extra heavy-duty wheel guards.

A simple formula at the end of our Metal Removal Evaluation Work Sheet converts comparative cost factors into potential savings obtainable with high-speed grinding.

Ingersoll-Rand

METAL REMOVAL EVALUATION WORK SHEET

Work Station _____ Date #1 _____ Date #2 _____

Material to be Ground _____ Type of Grinding _____

	Present Method I		High Speed Grinding II	
1. Type of Grinder				
2. Grinder Cost				
3. No. Grinders in Use				
4. Air Pressure at Grinder while operating				
5. Hose Size				
6. Wheel Brand				
7. Wheel Grade				
8. Wheel Size				
9. Wheel Price	Maximum	Minimum	Maximum	Minimum
10. No. Wheels Used/Shift				
11. Use Factor—Actual Grinding Time				
12. Work Output/Shift				
13. Cost/Shift (Labor & Overhead)				
14. Wheel Cost/Shift (Wheel Price x No. Wheels Used)	Maximum	Minimum	Maximum	Minimum
15. Cost Pc = $\frac{\text{Line 13} + \text{Line 14}}{\text{Line 12}}$				

16. Savings/Shift = (Cost/Pc II − Cost/Pc I) × (Work Output II − Work Output I) =
a. Max Wheel Cost _____ b. Min Wheel Cost _____
17. Total $ Savings/Day = No. Grinders × $ Savings/Shift × No. Shifts =
a. Max Wheel Cost _____ b. Min Wheel Cost _____
18. Annual Savings = Total $ Saving × 240 Working Days = a. _____ b. _____
19. Cost New Method = No. Grinders × Grinder Cost _____
20. Actual $ Savings First Year = Annual Savings − Grinder Cost =
a. Max Wheel Cost _____ b. Min Wheel Cost _____

When grinding costs were becoming noticeably higher at AMF Beaird, Inc., Shreveport, La., the firm switched from conventional-speed tools to Ingersoll-Rand 22FH and 43FH grinders. Now four operators do the grinding that previously required as many as six operators, relieving those other operators for other jobs. Grinding time per unit is reduced by an estimated minimum of 15 percent. The lighter weight of these new tools also reduces operator fatigue. Natural-grasp, comfortable handles contribute significantly to higher man-tool capacity over a full shift at AMF Beaird.

Mobile Pulley & Machine Works, Division of Lehigh Valley Industries, Mobile, Ala., is an international supplier of large, heavy duty pumps, pump components and other equipment used primarily in the dredging industry. This firm reduced grinding time 45 percent with a 31HL80 and a 43FH Vertical High Speed Grinder from Ingersoll-Rand. Wheel wear was reduced 33 percent. Total abrasive wear was reduced 40 percent. Metal Removal rates were increased many times, greatly increasing the potential for savings on individual jobs.

The Upward Trend in Lowering Materials Handling Costs

The 1960s produced the space age. Man rose to new heights, finally reaching the moon in August of 1969. In the 70s, man again is reaching for new heights, this time on the ground. With materials handling a major portion of the manufacturing dollar for many manufacturers, production engineers are looking for ways of improving materials handling operations to obtain lower over-all manufacturing costs.

In our discussions with manufacturers, many pointed to the automatic storage/retrieval system as a solution to their storage problems. Some have had difficulties with such systems, but the general consensus is that "going up" is a definite possibility in their future planning. However, the materials handling problem is not one of isolated instances. In a recent survey that one manufacturer conducted, it found over 30 percent of its manufacturing costs are related to materials handling. Other manufacturers feel the figure may be higher.

Three major problems keep reoccurring in our discussions about materials handling: One is the search for space; another the lack of flexibility in handling systems at the work station; and the last is transporting materials.

The general trend in industry is to go up for storage. But moving materials upwards is not limited to storage; how to get good material flow in a multi-story building is an additional problem. And the problem is not limited to older buildings. Carl Insel, director of manufacturing, Motorola, Inc., Roselle, Ill., puts it into proper perspective: "We have a new plant, barely five years old, and we are experiencing problems with materials handling. Part of the problem has been our fantastic growth and the inability to lay out the facilities to keep pace with this growth."

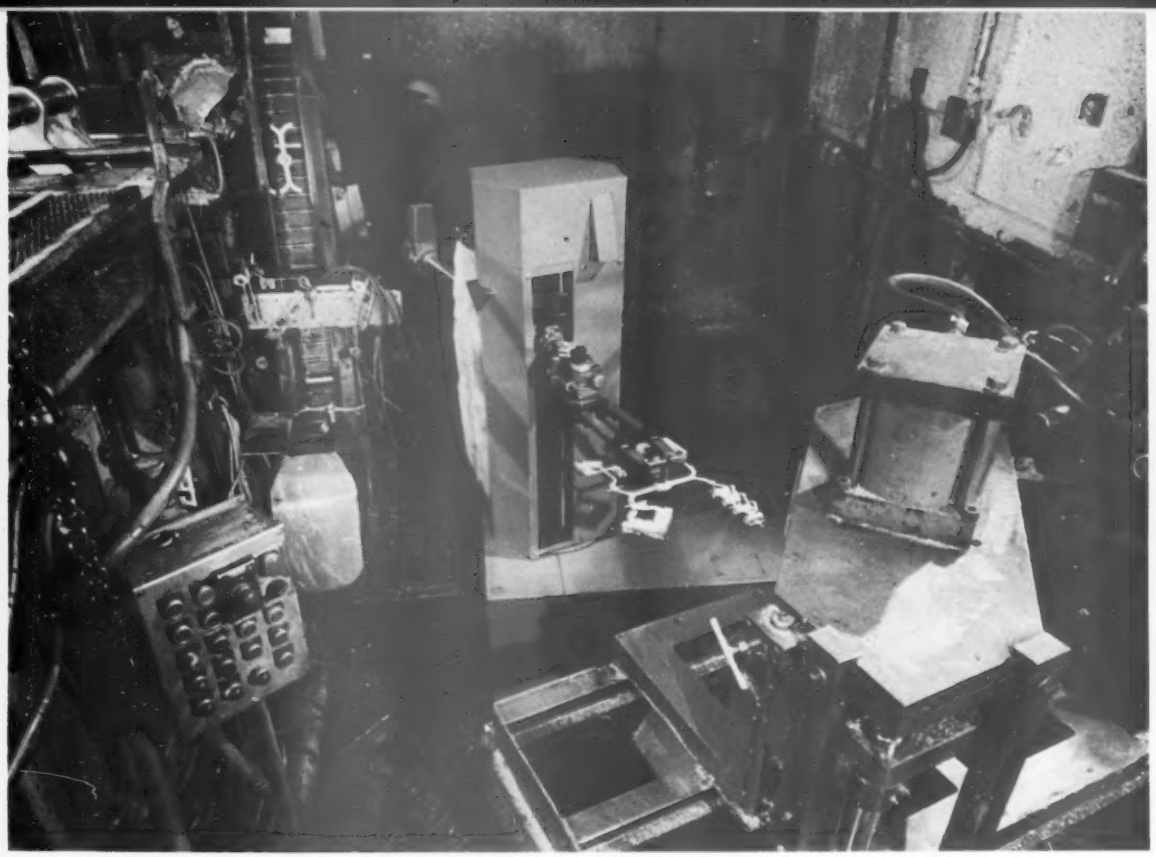
Planning Storage/Retrieval Systems. Probably the biggest pitfall in planning a storage system is locking the system into an existing building or building design. Far too often, a manufacturer goes to the architect first, and then tells his handling people or handling consultant to: "Make the system fit." Anyone connected with the materials handling profession considers it vital to be in on the original facility layout.

As a preclude to storage system design, one also should look at the existing product line and then forecast for future products and markets. Dr. William Lazer, professor of marketing, Michigan State University, states: "In the next 10 years, 80 percent of all the products we use will be absolutely new." Any storage plant, therefore, should take into account whether the product will be around after you've finally devised the system for storing it.

In conjunction with that product and market forecast, you also need a handling philosophy for using unit loads and standardizing those loads. Endorsing this concept is Vincent Spedale, vice president-manufacturing, Truck Division of International Harvester Co., who says: "High density storage provides a very good payoff. But before you go into it, you have to get with your vendors and ask them to supply your materials in specific shapes. You can have several variables, but they must be kept within limitations in order to put it in a cube."

Vincent J. Spedale
International Harvester Co.

Some Don'ts. We asked leading systems manufacturers for comments on what the customer does wrong when he's investigating



This AMF Versatran industrial robot increased the productivity of this die casting operation by 30 percent. Workers preferred not to work in the area because of spattering metal and heat

storage/retrieval systems. The following were on their lists:

1. *Almost universally, the customer does not really know his product.* The customer needs to know what materials are being handled. What is the product's activity? Will it remain the same throughout production—does its size change, what value is added on, does it become more fragile? In essence, most people have trouble defining their loads.

2. *Many manufacturers tend to be over-conservative when specifying.* In analyzing a company's product, each person who participates tends to increase the specifications until what the system is designed to handle is completely unrelated to the original product.

3. *Too much automation.* One can buy anything he wants to, but that doesn't necessarily mean it will handle the product economically. One stacker crane maker told us: "Why automate the input and output, when a lift truck may do the job?" A user often wants to tie its system into a computer when a mini-computer could handle an adequate system.

4. *Unrealistic requests for proposals.* Most manufacturers want a variety of layouts to choose from, and they want an answer immediately without allowing time for a complete analysis. Layouts are expensive to make, and many system builders feel the customer should be more realistic when analyzing his system. In fact, a user may be better off buying the engineering of a proper proposal rather than trying to get several poorly conceived proposals.

5. *Inadequate confidence in in-house personnel.* Many manufacturers are afraid of the reliability/capability of their own personnel. They need to remember that these are the people a prospective supplier must talk to in order to get the facts needed for designing a system. The comment made by a vendor applies: "The in-house engineers are the same breed as the consultants and as the suppliers. They have the same engineeering backgrounds and know the product better. These are the people we should be dealing with. They should actively participate in the design, construction, and operation of the system."

6. *Uncertainty over financing method.* A decision that must be made early in the proposal stage is the method of financing the acquisition of the material handling equipment. Stackers can be large capital decisions, and options to consider should be outright purchase, borrowing the funds, or leasing.

Generally, suppliers feel that they can supply the system for tne manufacturer's problem. However, they also feel that unless they are given proper information and unless someone representing the customer is really involved in the project, the system may not perform as expected.

This problem was echoed by a Northern Illinois manufacturing manager. He "inherited" a large stacker system that didn't work. He wasn't involved in the original project, and many of the concepts

used in the system design were not necessary for that particular product. His comments: "We went too far. Had we taken one step at a time, we might have gotten there. We actually had an order picking problem and did not need a computerized stacker system.

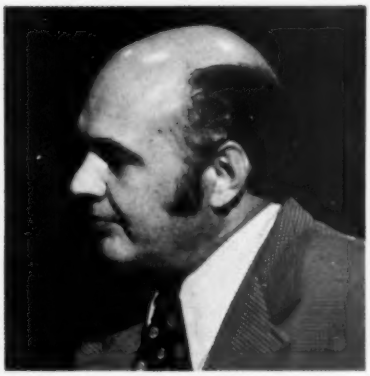
Donald Lorton
Whirlpool Corp.

However, not everyone is disenchanted with the stacker. Donald Lorton, corporate director of facilities planning, Whirlpool Corp., Benton Harbor, Mich., exclaims: "We are pretty excited about the stacker. We have two systems, with one of them going 60 ft in the air. We are also thinking about using stackers for an in-process manufacturing operation."

George Markell, Industrial Truck Division, Clark Equipment Co., states that there are three major ways to stack goods—the fork truck, stacker cranes, and the storage/retrieval system. Sixty ft is the normal stacking height for a storage/retrieval system, although there have been systems higher. A stacker crane stores to about 40 ft, and industrial lift trucks are limited to about 25 ft.

Carl Insel of Motorola states that lift trucks work quite well for them. Insel says: "I am responsible for a 50,000-sq-ft warehouse that has a 25-ft storage height. We have something that is somewhat unique, and we are very happy with it. We operate in 5-ft aisles using a Drexel lift truck that has a 90-degree swing of the fork mast."

However, storage does not always have to be stacked. There are many live storage systems incorporating various conveyors that can take advantage of overhead air space. Nor are all storage problems related to in-process or finished goods. Scrutiny of incoming materials is pointed out by Julius Vetter, president, Louis Allis Co., Milwaukee, Wis.: "I think space is getting to be more and more a valuable commodity in the plant. Instead of stacking sheet steel, we are thinking of placing it on end. Accessibility would be greatly increased, and because there will be less handling, there will be less product damage."



Carl Insel
Motorola Inc.

The consensus of most manufacturers is that storage is going to go up and not out. Land is becoming too expensive. Likewise, building costs are increasing, and it is more economical to go up rather than out. Utilization of the "cube" is maximized by going up. And to go up requires equipment that is semi- or fully automated, which in the long run reduces labor.

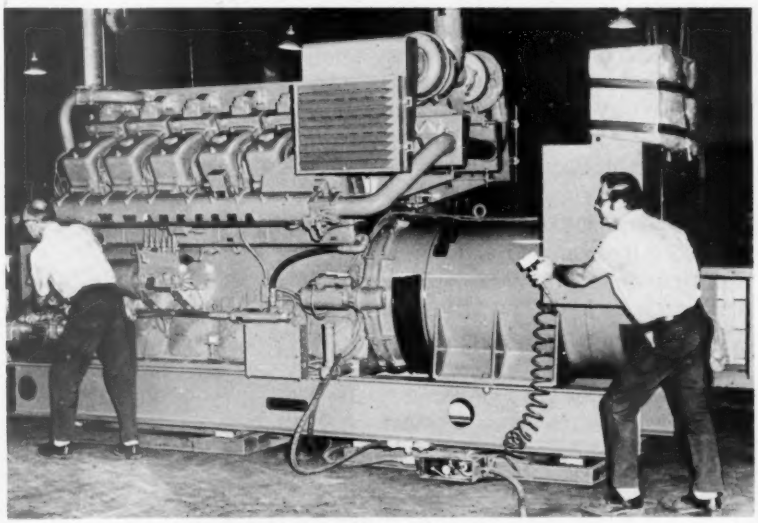
Parts Delivery to/from Work Stations. Many machine operations are automated or at least semi-automated; along with DNC, NC, etc., machines have been enabled to disgorge parts at undreamed of rates, and the race is on to see how we can increase each machine's production rate by fractions of a percent.

Yet a machine can only be as efficient as the feeding and removal of the parts it processes. As Julius Vetter, president of Louis Allis, so bluntly and so aptly expresses it: "My theory is everytime you touch a product, you screw it up a little bit. You get kind of sick when you walk through a plant and see somebody taking a rotor that is highly machined and balanced moving it from one machine to another by rolling it along the floor."

Parts handling is equally frustrating to C. D. Seidler, manager, new products planning, Teletype Corp., Skokie, Ill.: "I don't have any solutions. But I'm looking for one.

"If you can visualize 7000 or

Two men easily move a 36,000-lb motor generator using a Rolair air film transporter



An unusual application of a guided tractor system is this Barret Guide-O-Matic that pulls pallet jacks as trailers. The method eliminated the need of lift trucks at the various unloading stations on the tractor's 2,000-ft run

8000 parts floating around the shop at any one time—I'm referring to small calculator parts, very intricate in shape, very intricate in tolerance—how do you move these items around in big factories? How do you protect them so they are not damaged, or distorted from the time you get through machining them, through inspection, quality control, and back to the assembly line?"

Most of the manufacturers we talked with are willing to try new ideas and work with vendors, share the cost of research and development, and pay for studies.

Materials handling is a top priority at Caterpillar Tractor Co., Aurora, Ill. Charles Eberhardt, manufacturing manager, explained a new air pallet assembly line system his plant is using: "We use air pallets for assembling our large excavators. With the pallets, we can pull a unit from the line at any time and correct any problems. The pallets are driven by air motors, and they are sequenced to move from station to station. Nothing comes off the end of the line without working perfectly. This system works beautifully!"

Charles Eberhardt
Caterpillar Tractor Co.

The industrial robot is also being used in moderate quantities. At this point, many companies are using them on a more or less experimental basis. This explanation is offered by Walter Sauthoff, manager-plant engineering equipment, A. O. Smith Corp., Milwaukee, Wis.: "We have four robots in operation day and night. We are watching them and consider them as experimental. We keep close records as to what they cost, what their maintenance requirements and downtime are, and we find that they are doing a good job."

Robots have come a long way since their introduction less than 10 years ago. However, of the approximately 100 robot manufacturers in the world, only a dozen or so are located in the United States. The Europeans and the Japanese are finding these devices excellent solutions to the labor shortage. In the United States, robots found their initial application in hazardous areas or on distasteful jobs. From running die casting machines, to disarming bombs, the robot is a dependable worker. It doesn't care about the atmosphere and noise doesn't mean a thing.

Importantly, the robot can be reprogrammed for new jobs. Skid mounted, the unit can be taken to a new operation and with a minimum of changes become a functional piece of equipment again. The more hours it works, the cheaper its cost of operation.

Material Transporters. Although A. O. Smith is experimenting with robots, its automation of the material handling function is nothing new. Comments Walter Sauthoff: "In our press shop, we use automatic loading and unloading devices. Such devices have always been available, but OSHA opened our eyes. It forced our engineering department into developing a line of our own.

"Our main handling device is the lift truck. We have 250 of these yellow pieces running around but they are a real pain. They do a job, but they run more buildings down and ruin more crates than one can imagine."

A prevalent problem with the lift truck obviously is its driver's

Walter Sauthoff
A. O. Smith Corp.

carelessness. Almost every major lift truck manufacturer offers a driver training course. Towmotor Corp., subsidiary of Caterpillar Tractor Co., made an excellent movie several years ago called "Color of Danger," which is available as a training film. And driver safety was emphasized long before OSHA came into effect.

The much maligned lift truck has undergone many changes during the past decade and still is one of the most indispensable handling devices around. As an inexpensive and versatile piece of equipment, it is often the first mechanical device an incoming worker is allowed to use. This perhaps touches at the heart of its problem more than anything else. The lift truck is the universal manipulator. When a plant has trouble lifting loads, the first thought is to get a lift truck; the second thought is to take the lowest paid worker and let him operate the thing. And the final idea is to run it "forever."

George Markell of the Industrial Truck Division of Clark Equipment points out, however, that the average life for an industrial truck is five years. This does not mean that the truck is no longer operative, but at this point the truck probably costs more to run and maintain than a new one. Using a 4000-lb gas-powered truck as an example, he states that the total expenditures, including purchase price, for the unit over a five-year period is $12,150. During that same period, the driver may receive over $50,000 in wages. By using a worn out and obsolete truck, the operator's productivity decreases—a poor way of trying to save money.

Problems with transporting materials are not limited to lift trucks. As one plant manager explained: "I have five miles of overhead conveyor hanging in my plant that is not usable anymore. I think the biggest challenge in materials handling is maintaining flexibility."

Although this user looks at some equipment as not being flexible, a representative of Jervis B. Webb Co. states that a good share of its total business comes from revamping equipment for product changeover. He points out that an overhead conveyor seldom wears out and that all the components of an overhead system can be easily moved by millwrights. Conveyors, in fact, are not the only materials handling items that can be moved. Triax Co. says it has moved entire storage/retrieval systems at tremendous savings to the user.

Packaging Problems. A material handling problem that is becoming larger every day is packaging. Cardboard has become scarce. A way out may be greater standardization. Carl Insel of Motorola says they now are using one basic corrugated box to package three major product lines. They have reduced their corrugated box inventory from 27 types to just 7.

Strapping materials also are becoming scarce. As one supplier of strapping puts it: "In the plastic strapping area, we may have a problem in 1974. We anticipate a shortage of raw materials. Likewise, steel strapping may also become a problem."

Our Daily Bread. In summarizing the materials handling problem, Walter Sauthoff of A. O. Smith expressed it well when he said: "We are constantly improving our materials handling. *This is our daily bread.* We do it every day of the week. The ideas originate in manufacturing engineering and in the shop where people are on the line. These are where the ideas come from. We develop them and make them workable!"

Are You Guilty? Many of the user problems in material handling equipment selection are self-in-

TRANSPORTING EQUIPMENT	Self Loading	Load-unload Stations	Flexibility	Distance Travelled	Initial Cost	Aisle Space	Product Damage	
Fork Truck	B	A	A	C	C	A	B	
Pallet Truck	B	A	A	D	A	A	B	
Manual Tractor	C	A	A	B	B	A	B	
Driverless Tractor	C	B	B	A	D	C	A	
Conveyor	A	D	C	B	D	D	A	
Towline	C	C	C	B	D	C	A	
Monorail	B	C	C	B	D	B	A	

STACKING EQUIPMENT	Flexibility	Cube Utilization	Material Control	Initial Cost	Operating Cost	Stacking Height	Product Damage	No. Shifts To Justify	
Fork Truck	A	C	C	A	B	C	C	1	
Stacker Crane	B	B	B	B	B	B	B	1 to 2	
Automated Stacker Retriever	C	A	A	C	A	A	A	2	

The characteristics of handling devices used for transporting goods are rated in the top chart, with the rating of stacking equipment shown in the lower chart. Courtesy of the Industrial Truck Division, Clark Equipment Co.

flicted. Surveying several equipment suppliers, we come up with the following recommendations:

1. Very little is done in preparing user personnel for acceptance of new equipment, and very little is done by the user to properly maintain his equipment. One supplier comments: "Often we guide the customer to select systems his personnel are capable of maintaining rather than count on him to upgrade his maintenance capacity."

2. It is common for a user to be short-sighted when it comes to evaluating equipment. Many times the lowest dollar investment is selected over a more extensive system that would afford a bigger return on investment. A supplier says: "We (the supplier) can only lead him (the user) to water (the recommended system). We can't make him drink it."

3. Systems are often sought without correct determination of the proper parameters of the handling requirements. Customers often fragment systems by departments rather than examine their material handling problem in total.

4. Customers are often guilty of spreading orders for a complete materials handling system among several vendors. This ignores the high cost of interfacing equipment and the lost opportunities for improving the over-all handling scheme possible when a single vendor can see the problem in its entirety. ■

Materials handling deficiencies show up in all areas of production processes. Limiting a materials handling analysis to just a simple check list is virtually impossible as any good materials handling program should begin with the original plant layout. However, The Material Handling Institute, Inc., recommends the following checklist as an indicator of inefficient materials handling.

INDICATORS OF INEFFECTIVE MATERIAL HANDLING

	CHECK Yes	CHECK No
GENERAL		
1. Crowded Conditions		
2. Lack of provision for expansion		
3. Empty floor space		
4. Poor housekeeping		
RECEIVING, SHIPPING & STORAGE		
1. Demurrage		
2. Truck tie-ups		
3. Cluttered docks		
4. Manual loading & unloading		
5. Excessive temporary storage		
6. Material piled directly on floor		
7. Wasted "cube"		
8. Disorderly storage		
PRODUCTION		
1. Unexplainable delays and idle time		
2. Stock control difficulties		
3. Decreased production in an area		
4. Bottlenecks in production		
5. Backtracking		
6. Material piled directly on floor		
7. Obstacles in material flow		
8. Scheduling difficulties		
9. Low production density, i.e. production/sq. ft.		
10. Idle equipment		
11. Related operations spread over an unnecessarily large area		
12. Use of "process layout", when "product layout" could be used		
13. Improper location of feeder, or subassembly lines		
14. Inspection not integrated with production		
15. Improperly located service areas		
16. "Vanishing" aisles		
17. Zig-Zag flow lines		
18. Non-uniform rate of flow		

	CHECK Yes	CHECK No
MATERIAL HANDLING METHODS		
1. Hard, hazardous work, being done by hand		
2. Excessive material handling equipment repairs		
3. Unnecessary handling		
4. Long hauls		
5. Uneconomical handling methods		
a. manual		
b. failure to use gravity		
c. overlooking inexpensive handling equipment or devices		
6. Two-man lifting jobs		
7. Frequent manual handling of similar material		
8. Failure to use standard containers for in-plant handling		
9. Failure to use standard m.h. equipment for in-plant handling		
10. Rehandling		
11. Non-integrated material handling equipment		
12. Material being moved one piece at a time		
13. Material not delivered right to the work place		
MATERIAL		
1. Damaged material		
2. Excessive scrap		
UTILIZATION OF MANPOWER		
1. Excessive injuries		
2. Employee compalints		
3. Large numbers of men moving material		
4. Handling done by skilled labor		
5. Safety hazards		
6. Two-man lifting jobs		
7. Operators walking for materials		
COSTS		
1. High overhead costs		
2. High indirect labor payroll		
3. Unexplainable cost increases		

SUMMARY OF SUGGESTIONS FOR IMPROVEMENT

useful literature

A new concept in air distribution for materials handling and production lines

is described in a 20-page brochure. (Gardner-Denver Co.)
Indicate No. 478 on card

Multi-motion actuators, air and hydraulic, for transfer, press loading, clamping, and

work performance are described in a 14-page brochure. (PHD, Inc.)
Indicate No. 479 on card

Cranes and monorail systems are described in a 12-

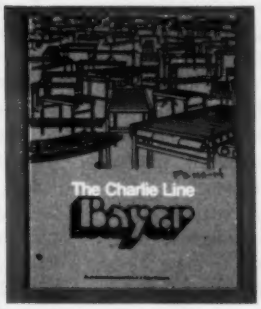
page brochure. (Whiting Corp. *Indicate No. 481 on card.* **Heavy-duty** industrial cranes are described in a 12-page brochure. (Whiting Corp.)
Indicate No. 482 on card

A complete line of single circuit, silicon-diode rectifier-type battery chargers is described in a 6-page brochure. (Hobart Brothers Co.)
Indicate No. 483 on card

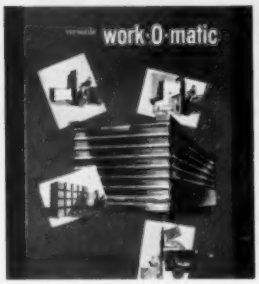
Basic Conveyor Application is a 16-page practical guide

to the understanding of simple conveyor applications. (Litton UHS)
Indicate No. 484 on card

Power-and-free overhead conveyors are described in a 4-page brochure. (A. J. Bayer Co.) *Indicate No. 485 on card.* **The "Charlie" line** of pre-engineered floor and overhead conveyors is described in a 38-page publication. It includes skate-wheel, roller, powered belt, and live roller conveyors. (A. J. Bayer Co.)
Indicate No. 486 on card



The Work-O-matic container system of materials handling is described in a 10-



page brochure. (Union Metal Mfg. Co.)
Indicate No. 487 on card

Materials handling equipment and services are described in a 36-page brochure. (Rapistan Inc.)
Indicate No. 489 on card

What you should know about accumulation conveyors is presented in a 4-page brochure. (Rapistan Inc.)
Indicate No. 490 on card

Making the most efficient and economical selection of lifting magnets, electro or permanent, is described in a 22-page booklet. (Eriez Magnetics)
Indicate No. 491 on card

A guide to in-floor towline conveyor systems is presented in this 16-page brochure. Various manufacturing as well as warehouse applications are included. (SI Handling)
Indicate No. 492 on card

Recommendations for safer utilization of storage racks are contained in a 6-page brochure from material developed by the Rack Manufacturers' Institute. (Sturdi-Bilt)
Indicate No. 493 on card

An analysis of installing an automatic parts transferring system to a press is cov-

continued on page 141

The **Ingersoll-Rand**
Approach to Materials Handling

FOR PRODUCTIVITY AND SAFETY—CHECK YOUR OVERHEAD LOAD HANDLING

BY: L. Smetana, Marketing Manager, Materials Handling
D. Kushner, Sales Manager, Overhead Systems

Are your air hoist operators taking longer every day to complete basic load handling chores? Maybe it's not the operator's fault. Maybe you have "tired" hoists. If you do, you're losing production and payroll dollars because more money is buying less output. Your profit is suffering. And so is safety.

Likewise you may also have a complete handling system which is sluggish. And if you don't have an overhead system, now's the time to consider one.

Our studies indicate that many air hoists in use today are operating at 30 percent and more below their rated efficiency. If you have 10 such units, you're paying $18,000 for non-productive hoist operations. Here's why. Those same studies indicate the average hoist in production service is used 60 percent of the operator's working time. If the operator's annual wages, including fringe benefits, average $10,000, you have:

10 x $10,000 x .60 (use factor)
x .30 (inefficiency factor) =
$18,000

Only through a program of regular inspection, testing, and maintenance on your air hoists will you be able to keep them operating at optimum efficiency. All components of your system should be checked: your compressed air system that drives the hoists, the air motors, the brake system, the wire rope or chain, the scheaves, drums, trolley wheels, and hooks.

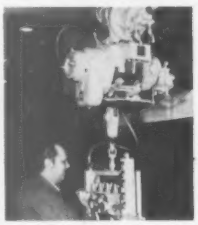
The trouble-shooting check list such as the one shown will help to identify deficiencies in your hoist or air system that can decrease air hoist efficiency. An accurate maintenance log should be kept on each hoist in your shop.

Your inspection procedure should include a frequent check (daily to monthly intervals) of all mechanical equipment; air and hydraulic systems, hooks, chains, ropes, brakes, and slings for excessive wear. The periodic inspection (1 to 12 month intervals) should include checks for cracked, deformed or corroded members, loose bolts or rivets, worn, cracked, or deformed parts, such as pins, bearings, shafts or gears. Reliable manufacturers of hoists are as concerned with safety in your plant as you are. Their maintenance instructions and repair parts lists will be of significant value to you. Make sure you have it and to insure proper and safe operation, follow their maintenance recommendations and obtain replacement parts from the original manufacturer.

Your program should also include a scheduled replacement of old hoists with new ones, not only to improve your productivity, but to insure safety. A hoist will eventually reach a point where it is uneconomical to repair it to bring it to an acceptable level of operating efficiency and safety.

	Air Leakage	Air Strainers Clogged	Air Pressure Too Low	Dirty Air	Water in Air	Incorrect Lubrication	Insufficient Lubrication	Hose Too Small	Long Vanes	Worn Vanes	Rotor Rubbing	Worn Bearing Plates	Worn Valve Seat	Throttle Pin Sticking
Motor Won't Run		X	X				X		X		X			
Lack of Power	X	X	X			X		X		X	X	X		
Speed Too Low		X	X					X			X			
High Air Consumption	X									X		X		
Excessive Vane Wear				X		X	X							
Excessive Bearing Wear				X		X	X							
Rusting of Parts					X	X	X							
Delamination of Vanes				X	X	X								
Vanes Chipping				X		X	X							
Motor Continues to Run, Throttle Off													X	X

Air Motor Troubleshooting Checklist.



A moving air logic control system may be retrofitted to any piston hoist in our line that provides lifting capacities from 500 lbs. to 10 tons. The system eliminates solid state controls, potential electric shock and spark-induced explosion hazards. One power source, compressed air, feeds both the hoist controls and the hoist's air motor. The system may be programmed to provide semi-automatic or completely automatic hoist operation after manual initiation of a cycle.

To maximize productivity and profits, use your "air space" to replace existing but less effective handling procedures. An overhead system which includes a bridge or jib crane, the hoist and the proper handling fixture or grab should be considered whenever possible. Why? Overhead systems do not take up the aisle space required for lift trucks, they are less costly to maintain, and overhead systems are usually one-man operations, while other methods may require two or more men.

A simple overhead system can usually be written off in six months or less, and the more sophisticated systems will pay back in a matter of a year or two at the most, based on improved efficiency.

In most cases an overhead system is easy to operate. No special operators or complicated training procedures are required.

Overhead systems are also safer to use—built in are proven design, construction and performance features that meet or exceed present safety standards. Not only does the overhead system free the worker from backbreaking labor, but it moves goods from station-to-station with greater ease, saving time and increasing production.

INDICATE NO. 246 ON BUSINESS REPLY CARD

Materials Handling

useful literature

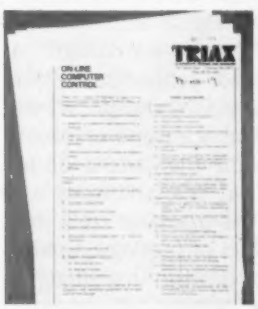
continued from page 139

ered in a 30-page report. (Auto-Place)
Indicate No. 494 on card

An 8-page brochure describes the application of a

live roller conveyor system. (Ermanco Inc.)
Indicate No. 495 on card

Requirements for installing an automatic storage re-



trieval system are covered in an 8-page report. (Triax)
Indicate No. 496 on card

So You're Going To Buy A Conveyor System? is a 24-

page booklet designed as a tool to help bridge the gap between a busy industrial management and a rapidly expanding materials handling technology. (Rapistan Inc.)
Indicate No. 488 on card

A 24-page "primer" covers the various arrangements

for feeding roll materials into presses. (Perfecto)
Indicate No. 497 on card

A series of brochures from Jervis B. Webb covers overhead and roller conveyor systems as well as other materials handling applications. **"Dog Magic"** is a 20-page brochure on power-and-free conveyors. *Indicate No. 498 on card.* **Overhead trolley conveyors** are covered in a 100-page man-

ual. *Indicate No. 499 on card.* **A 48-page brochure** describes enclosed overhead conveyor systems. *Indicate No. 500 on card.* **Automatic monorail systems** are described in an 8-page brochure. *Indicate No. 501 on card.* **"Spanmaster"** overhead crane and monorail systems are covered in a 16-page brochure. *Indicate No. 502 on card.* **Custom conveyor systems** are described in a 12-page brochure. *Indicate No. 503 on card.* **An analysis** of storage rack systems is made in this 30-page manual. *Indicate No. 504 on card.* **Techniques** for automatic dispatching are covered in this 20-page brochure on overhead and in-the-floor tow conveyors. *Indicate No. 505 on card*

A vacuum conveyor for transport of irregular shaped or fragile products, called the Vac-Q-Veyor, is described in a 4-p. bulletin. (Herr-Voss Corp.)
Indicate No. 506 on card

Versatility is featured in the Master Handling System described in a 6-p. fold-out brochure. (Scans Associates, Inc.)
Indicate No. 507 on card

"Increased Productivity in Machine Loading" through use of industrial robots is explained in a 6-p. brochure *Indicate No. 508 on card.* **Use of Unimates** in die-casting applications is described in a 4-p. bulletin. *Indicate No. 509 on card.* (Unimation, Inc., division of Condec Corp.)

"Build Your Own Crane Kit" is the subject on a literature packet assembled by Hoist & Crane Division. *Indicate No. 510 on card.* **Cost-cutting ideas** on monorails, cranes, and stackers are contained in a 64-p. manual from Cranes & Monorail Systems Division. *Indicate No. 511 on card.* **Power-and-free conveyor systems** in a variety of manufacturing applications are shown in a colorful 12-p. booklet published by Chain Conveyor Division. *Indicate No. 512 on card.* **Automatic palletizing systems** are shown in an 8-pager from Unit Conveyor Division. *Indicate No. 513 on card.* (Acco)

Automate

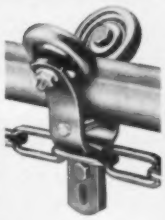
For ONLY $2.75* Per Foot !

* Light duty track with trolleys 24" O.C.
$3.90 per foot — 12" O.C.

ECONO INSTALL YOURSELF OVERHEAD MONORAIL **CONVEYORS**
From Stock Components

Your own workmen can assemble stock ECONO track and other components into a custom designed conventional type conveying system to suit your precise needs — at a fraction of usual overhead conveyor cost!

Speed up material movement and production flow — gain the benefits and cost saving efficiencies of automation with a flexible, low cost ECONO installation.



Power and Free Systems

Power and Manual Systems

Smooth rolling ECONO trolleys provide dependable load movement in chain driven powered systems or in manual operating systems. Heavier loads are safely handled by combinations of trolleys and load bars, such as shown at left.

500 lb. Capacity

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INDICATE NO. 247 ON BUSINESS REPLY CARD

Catching Up To The Computer Age— The Manufacturer's Dilemma

The major problem in the process control area is the lack of user education and training. This deficiency is not limited to any particular group; it shows up in all levels of management, engineers, and workers.

Techniques abound and new developments occur faster than the old ones can be tried out and understood. Many new ideas become obsolete before they get off the drawing board as the control revolution marches forward in double time. The fluidic manufacturers bemoan the fact that the transistor and electronic age arrived just as they had their device ready for market. Users were being snowed under by NC and computers—and they were in no way ready to assimilate the technological know-how required.

R. J. Keyser
Fairbanks Morse Division

Most users are in favor of the new technologies. They know it will increase productivity and afford their plants a host of new benefits. However, along with the good comes the bad.

R. J. Keyser, vice president of manufacturing, Fairbanks Morse Division of Colt Industries, is typical in his comments about control problems: "When we bought a tape-controlled, sophisticated machine, we originally thought all we had to do was load and unload it —the machine then would do all the work. But it didn't turn out that way. The machine isn't that smart. Instead of putting one low-grade man on the machine, it takes a real high-grade worker."

Another problem is the lack of standardization in the field. C. D. Seidler, manager of new products planning, Teletype Corp., says: "We have gone through a period during the past 10 years where some people in the organization were against NC and some were for it. Fortunately, we did buy some. However, we never standardized. It would have been much more desirable if we had, as service and training would have been much easier."

Echoing Seidler's comments, John Sedoric, vice president of manufacturing, Paper Machinery Division, Beloit Corp., adds: "I don't know what your program is, but standardization is the first step you take. If you don't, by the time you get everyone's system in,

C. D. Seidler
Teletype Corp.

you will need electrical engineers, not electricians, to maintain them."

Equipment manufacturers agree that training is a potentially troublesome area when it comes to controls. Allen-Bradley and Digital Equipment Corp. are quick to point out, however, that the new controls are not a maintenance problem if the plant's electrical maintenance workers are adequately trained before the new equipment is brought in.

The importance of upgrading the maintenance force cannot be taken lightly. The Industrial Development Division of the University of Michigan's Institute of Science and Technology predicts that by 1978, almost 25 percent of all equipment failures in the U.S. metalworking plants will be detected and diagnosed by the computer.

Growth of the use of computers in industry is phenomenal. General Automation, Inc., states that the industry segment of the computer market is about $100 million, and anticipates that within five years, this field will total more than $300 million annually.

Guarantees of Performance. Most manufacturing managers are caught in the middle of the control explosion. While many of them have some idea what it is all about, they must place heavy reliance on their newer employees for control logic knowledge. Not only do the managers lack expertise, but they are being inundated with governmental requirements in the areas of environment and safety, and they want to be assured that what they buy will meet governmental codes and standards. James McCarthy, manager of manufacturing, Thor Power Tool Co., puts it this way: "The problem is to get controls that have a guaranteed OSHA compliance on them. Furthermore, controls are available for newer items, but lacking for older equipment."

J. J. Diamond, Rockwell Mfg. Co., states that control safety is a prime concern in the equipment they build. Calling attention to his company's voltage machine control unit, he says Rockwell is offering this unit at no price increase on all of the new equipment it manufactures. While stating that a considerable amount of the machines in use today is of World War II vintage and should be due for replacement, he says that with the high cost of maintaining and refurbishing older equipment to meet safety requirements, users would be better off to get new equipment with safety features and achieve higher productivity as an added benefit.

Spokesmen for Parker Hannifin Corp. point out that when it comes to safety, manufacturing personnel need not always look to electronics for conformance and reliability. Pneumatic controls have been used successfully in explosive atmospheres and in areas where liquids and steam are present. Richard Kiehl of Parker Hannifin comments: "Moving-part logic is an innovation that has widespread industrial use. This is a form of miniature pneumatic controls which should not be confused with 'fluidics.' Fluidic controls, which have no moving parts, enjoyed a flurry of interest in the late 60's. The fluidic system was incompletely developed, poorly explained, and sold in the wrong places for the wrong reasons. Moving-part logic, on the other hand, is coming into maturity rapidly, is easily understood, and is being applied in a practical and sensible manner."

Control manufacturers agree that there is more to the control business than programmable controllers or computers. Traditionally, electro-mechanical components have dominated the control field; however, pneumatic and electronic devices are being developed which promise improved reliability, safety, maintainability, cost, and size. Therefore, many factors must be considered when selecting a control technology for a given application.

Moving-Part Logic (MPL) Controls. MPL is miniaturized pneumatic control whose components provide all the basic input, logic, and output functions. Its main characteristics are high pressure, limited flow, and negligible consumption of operating media. MPL is entirely different from conventional pilot-operated pneumatic and hydraulic valves, or fluidics.

Pneumatic MPL controls somewhat resemble electrical controls. Housed in what look like electrical cabinets, they include a complete range of input, logic, and output devices. Inputs include pushbuttons, selectors, indicators, limit valves, position sensors, electric-to-pneumatic interfaces, and hydraulic-to-pneumatic interfaces. Logic devices include ANDs, ORs, memories, and timers. Outputs include MPL valves that can operate small pneumatic air cylinders directly, air pilot-operated pneumatic power valves, air pilot-operated hydraulic power valves, and air-to-electric interfaces.

Parker Hannifin's Kiehl states that maintenance of MPL has been greatly simplified. Most high-quality MPL relays are equipped with

Operating Characteristics of Various Control Media

Characteristic	Electro-mechanical	Pneumatic		Solid-State Electronic
		Moving Part Logic	Fluidic	
Expected Life	100,000 to 2,000,000 operations	10,000,000 to 500,000,000 operations	Indefinite	Indefinitely
Response Time	10 to 25 millisec	6-10 millisec	1-2 millisec	5-10 nanosec
Operating Rate	40 to 100 op/sec	100 to 150 op/sec	500 to 1000 op/sec	200 to 300 million op/sec
Fanout (ability of device to drive others)	over 20	Unlimited	4-6	6-10
Power Supply Regulation	Somewhat Critical	Not Critical	Not Critical	Critical
Relative System Size	Very Large	Large	Medium	Small

Environmental Characteristics of Various Control Media

Condition	Electro-mechanical	Pneumatic		Solid-State Electronic
		Moving Part Logic	Fluidic	
Temperature Extremes	Good	Acceptable	Excellent	Acceptable
Explosive Atmosphere	Poor	Excellent	Excellent	Good
Contaminated Atmosphere	Good	Acceptable	Poor	Excellent
Vibration and Shock	Poor	Acceptable	Excellent	Excellent
Electrical Noise	Good	Excellent	Excellent	Acceptable
Air Pressure Surges	Excellent	Acceptable	Poor	Excellent

Courtesy, Eagle Signal Industrial Controls Division, Gulf & Western Industries, Inc.

visual indicators which permit locating a system's malfunction quite readily.

Grahame Mountford of the Air Valves Division of Rexnord, Inc., feels that MPL has a great future because the logic calculations for setting up a control panel are quite similar to those used when setting up an electronic system. Another advantage is that MPL control is neither affected by electrical transients nor do they create any that could affect nearby electronic apparatus.

The Boolean Jungle. "The relay is dead, long live the transistor." That's an overstatement at this point. Although the electronic revolution is overthrowing many of the "old-time" relay systems, relays are still being used and will be for some time to come. Non-solid state components have their place in manufacturing and are well understood by maintenance electricians. When something such as "the relay" is well entrenched, it is hard to dislodge it with new technology.

But the manufacturing executive often comes into the new electronics through the products he manufactures for others and the products he uses at home. Robert Yanker, plant manager of Barber-Greene Co., states that he sees great potential in solid state controls because almost all new products his company builds contain them; as a result he can see their application in his shop.

In simplest terms, a solid state control device is one which incorporates various components made of solid materials that exhibit specific electronic characteristics. Such components include resistors, capacitors, diodes, transistors, and thyristors. Most solid state components fall into the category of semiconductors. In turn, a semiconductor consists of one homogenous piece of solid material whose molecular structure has been altered to achieve desired electronic characteristics.

To create a solid state control device, a number of solid state components are wired into a desired circuit configuration. Boolean algebra is a mathematical shorthand used for designing control circuitry.

As simple as all that sounds, the new electronics are not that simple. There are some inherent problems with them, and, unless compensated for in equipment design, problems may develop after the equipment they control is installed. A frequent problem is electrical noise. Nearby electrical equipment may generate an interference that can cause a controller to malfunction.

According to Frank Zammit of the Numa-Logic Division of Westinghouse, the most critical time for solid state control is early in its product life. Therefore, if such devices are thoroughly run-in before shipment, very few breakdowns should be encountered. Since the expected life for solid state is indefinite, maintenance problems will occur because of malfunctions rather than through wear.

Other control manufacturers agree. James Vandemore, Eagle Signal Industrial Controls Division, Gulf & Western Industries, Inc., states: "The best accepted measure of system reliability is the average mean time between failure (MTBF). Reliability is enhanced if components are designed to function within the operational and envionmental requirements of the application. Components should be purchased from a reputable supplier, who

can offer proof of good inspection practices. Further, the system should be subjected to a thorough burn-in program to avoid early failure in the field."

Another question is how far does one go with electronics? What is the difference between and when should one use fixed wired controllers, programmable controllers, or mini-computers? What about interfacing them with one another or even a central computer.

Allen-Bradley Co. comments that a successful DNC installation can begin surprisingly small and grow into a computer system of any size and capacity. The company's advice is: *Plan big, start small, and then grow.*

Although industry is in the midst of an electronic revolution, numerical controllers are in an evolutionary stage. According to James Conley, General Electric's NC sales manager: "Total systems control over NC operations offers distinct advantages to certain companies. But assembling a highly complex system is not without its problems." Conley indicates that while the present level of installed DNC systems may not be significant in numbers, the experience of users with installations to date proves their feasibility.

Instant Replay. Computerized manufacturing offers production personnel the same benefits that instant replay offers to TV sports fans. The production man can instantly have at his fingertips any process information required. He can know what is going on at the line, what goods are in shipping or receiving, and a complete rundown on his manpower situation.

Singer calls its production communication system the "Blue-Collar Computer System." Its operation is fairly typical of other computerized communication systems. The unit begins its work the moment an employee walks through the plant door. Through data punched into his badge, he is instantly recorded into the system. Within minutes, management can know precisely what the manpower size and profile is for the day. Any adjustments can be made at the beginning of the shift rather than later in the day after problems arise.

The computer also keeps close track of every job in the shop. Material shortages, down machines, or any other difficulties are flagged for immediate corrective action. By the end of the day, the system contains all information necessary for payroll, job status and department performance reports, and many other items that once could be obtained only through extremely time-consuming manual operations.

10 Steps For Planning a Manufacturing System

1. Know the capabilities of the central system so it can be maximized.
2. Know the inputs and outputs of the machine being controlled. Eliminate or minimize the need for manual overrides.
3. Take all manufacturing requirements into consideration beforehand. This should include knowing the environment the equipment will operate in as well as knowing diverse needs of all parties or departments that will be using the system.
4. Establish economic justification on equal terms with non-automated controls.
5. Standardize on equipment and software requirements.
6. Develop operator and maintenance training programs.
7. Develop scheduled maintenance programs and plan for backup system on critical processes.
8. Develop an acceptance test specification program.
9. Develop program for vendor coordination and scheduling.
10. Document system for follow-up program.

(Developed from information supplied by Digital Equipment Corp. and the Systems Division of Allen-Bradley)

At Rohr Corp., the computer can communicate with the shop workers. A computerized voice track verifies workers' request for materials.

However, plant communications need not be computerized to generate savings. The new communications system at the West Allis, Wis., Tractor Plant of Allis Chalmers Corp., contains nine 22-in. CCTV television monitors, three 8-in. CCTV monitors, and three cameras. The basic system is divided into three sub-systems with one covering each assembly line. Production managers have a visible record of what is taking place on the line, and cost savings are estimated at $12,000 annually.

Although controlling systems for inventory control, maintenance monitoring, plant security, etc., are as diverse as the controlling requirements for machinery, the reason for all systems are the same—cost savings. The NCR computerized inventory control system at C. A. Roberts Co., has reduced steel inventories by over 30 percent. E. A. Fox, in charge of the computer system, sums it up: "Over-all, our approach is not to have a showcase, but to show a payback on every job we put on the computer."

Power Transmission. In many of our discussions with manufacturing managers and engineers, transmission of power is seldom a major concern—until OSHA is mentioned. Noise, grease and oil spills, and guarding, all evoke considerable comments from users. Of the power transmission devices, hydraulics continue to grow in number and variety of applications.

Most current hydraulic development work and planning by equipment manufacturers is related directly to productivity and/or environmental requirements. According to Robert Thoren, Sperry Vickers: "Much work has been done on reducing the sound levels of hydraulic systems. The main thrust has been in pump modifications, but good progress also has been made in component sizing and mounting, piping, circuit design,

continued on page 148

save five ways by standardizing on Mark Century® NC

1. Widest Choice of Machine Tools
GE Mark Century numerical controls are now offered by 201 machine tool builders. This wide choice allows you to select your best possible machine value with the assurance that you can specify high-quality Mark Century NC with it.

2. Programming Is Faster, Costs Are Lower
Standardizing enables you to establish fewer and simpler programming routines. Your part programming, program maintenance, and training become easier and more efficient — thereby reducing costs.

3. Operator Efficiency Is Higher
Mark Century NC standardization allows machine operators to become more proficient. When they must handle more than one machine, this familiarity saves training time . . . increases production efficiency.

4. Maintenance Is Easier, Costs Less
Increased familiarity which comes with Mark Century NC standardization reduces troubleshooting time and saves on maintenance training. Your spare parts inventory investment can also be reduced because of greatly increased interchangeability of parts.

5. More Service Convenience, Accessibility
Mark Century NC standardization allows you to benefit more from GE's unparalleled services: over 90 field-based application and sales engineers, more than 200 NC trained service engineers in 90 cities worldwide, complete software support with post-processors for all major computers, GE operated NC maintenance training schools for customer personnel, and spare parts centers in key cities throughout the United States and Europe.

With nearly 20 years of NC experience we can give you many more cost-saving reasons to put General Electric Mark Century standardization in your NC planning. See your GE NC Sales Engineer or Machine Tool Builder Representative. Or, write General Electric Company, Section 530-17, Schenectady, N. Y. 12345

GENERAL ELECTRIC

continued from page 145

shielding techniques, and proper maintenance.

"Water-based fluids (90 percent water and 10 percent soluble oil) point the way to improved safety, easier disposal, and reduced fluid costs. The leakage problem is also getting attention. Newer approaches include straight thread connections, modular valves which minimize connections, and completely packaged and sealed drive units using a minimum of fluid.

"Increasingly sophisticated hydraulic circuits and components lend themselves to equipment automation. Examples are electrically modulated hydraulic valves which permit continuous electronic control of the circuit by computers and/or other electronic controllers."

What Is in the Future? Predictions by the Industrial Development Division of the University of Michigan's Institute of Science and Technology put the control issue in proper perspective:

By 1977: Part programmer time per part will be reduced by 25 percent.

By 1978: About 25 percent of all equipment failures will be detected and diagnosed by on-line computer software.

By 1980: Instantaneous computer displays comparing scheduled versus actual conditions will be employed in 25 percent of all manufacturing operations. More than 25 percent of all machine loading and scheduling will be done with computers. A new breed of production manager, familiar with computer methodology, will be commonplace.

By 1982: Production labor required per unit output of discrete part production will have decreased by 25 percent. One-fourth of all formed parts will be generated by complete software systems that optimize product, tool, and process considerations. One-fourth of all tools and dies will be engineered and/or designed with computer graphics.

By 1988: A 10 to 20 percent reduction in intermediate level management, per unit of work, will result from advances in information networks. ■

useful literature

High-performance, low-cost hydraulic pumps for pressures to 3000 psi are described in an 8-page fold-

out brochure. (Vickers). *Indicate No. 515 on card.* **Directional controls** for high-performance machinery are described in an 8-page brochure. *Indicate No. 516 on card.* **Adjustable-speed hydrostatic drives** are covered in a 10-page brochure. *Indicate No. 517 on card.*

Power Transmission equipment, a 20-page product directory. (Eaton Corp.) *Indi-*

cate No. 518 on card. **Off-the-shelf power transmission** equipment described at length in a 16-page brochure. *Indicate No. 519 on card.* **Cleveland modular fan-cooled speed reducers** are described in a 16-page brochure. *Indicate No. 520 on card.* **Dynamic adjustable-speed dc drives** and systems are presented in a 12-page brochure. *Indicate No. 521 on card.* **Adjustable frequency inverter** drive systems are presented in an 8-page brochure. *Indicate No. 522 on card.* **Cleveland heavy-duty speed reducers** are presented in a 32-page brochure. *Indicate No. 523 on card.* **The Cleveland speed variator,** a precision speed changer and torque converter, is described in a 24-page brochure. *Indicate No. 524 on card.* **Airflex standard clutch/brake** press packages and control systems are described in an 8-page brochure. *Indicate No. 525 on card.* **Farval centralized lubricating** systems are presented in a 14-page brochure. *Indicate No. 526 on card.*

A 62-page fluid power reference handbook contains standard engineering data, a glossary, and graphic symbols for fluid power di-

agrams. (S-P Manufacturing Corp.)
Indicate No. 527 on card

A 4-page, fold-out fluid compatibility chart aids in selecting the proper hose

for various chemical compositions. (Parker-Hannifin Corp.)
Indicate No. 528 on card

A 20-page illustrated brochure describes a series of

valves for controlling process, power, and instrumentation systems. (Parker-Hannifin Corp.)
Indicate No. 529 on card

Brochures on soldering systems, a solid state system for automatic electronic inspection, a parts caddy, and solid state industrial

metal detectors are included with other literature in a folder package. (ITT Industrial & Automation Systems)
Indicate No. 530 on card

The role for programmable controllers is presented in a 12-page conference paper. (Square D Co.) *Indicate No. 531 on card.* **Basic wiring diagrams** and short explanations for electrical control devices are

presented in a 58-page brochure. *Indicate No. 532 on card.* **Plug-in Norpak Solid State Control,** a 100-page manual, explains the basic principles of NOR logic as an introduction to a very detailed study of the various logic modules and accessories available. *Indicate No. 538 on card.* **Norpak Demand Control,** a 22-page manual, describes in detail the potential application of demand control and the savings it offers. *Indicate No. 539 on card.* **Program Sequence Control,** a 15-page brochure, describes one of the most efficient means of controlling machines or processes by step or sequential controllers. *Indicate No. 540 on card.*

A 130-page flexible shaft manual describes the advantages, functions, and nomenclature of flexible shafts. Cites a number of

successful applications. (S. S. White Division) *Indicate No. 541 on card.* The basic **operating principle of the Airbrasive jet,** by which a gas-propelled stream of abrasive particles is driven against the work, is described in a 16-page brochure. *Indicate No. 542 on card*

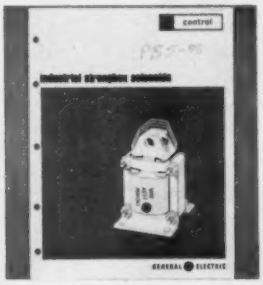
Hydraulic power units and components are described

in a 4-page brochure. (Miller Fluid Power) *Indicate No. 543 on card.* **Air switches** are described in a 24-page brochure. *Indicate No. 544 on card.* **Air logic controls** for simplifying air and hydraulic circuits are presented in a 16-page brochure. *Indicate No. 545 on card*

Various hydraulic and air cylinders supplied by Tomkins-Johnson are described in a series of booklets that also include the engineer-

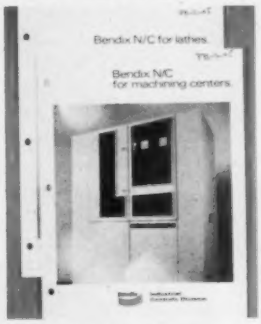
ing of hydraulic and air circuits. **Hydraulic Cylinders** is a 28-page manual. *Indicate No. 546 on card.* **An 105-page manual** on hydraulic and air cylinders up to 1000 psi oil and 200 psi air. *Indicate No. 547 on card.* **A 174-page manual** on medium-pressure air and hydraulic cylinders. *Indicate No. 548 on card.* **High-pressure hydraulic service** is a 140-page manual. *Indicate No. 549 on card*

Brochures from General Electric Co. on various con-



trol applications include both product and technical information. Most include installation guides and tips applicable to any control. **Track-type Limit Switches** is a 28-page brochure. *Indicate No. 550 on card.* **A 12-page brochure** on industrial strongbox solenoids. *Indicate No. 551 on card.* **A 16-page brochure** on leverless limit switches. *Indicate No. 552 on card.* **Transistorized static control** is explained in a 8-page brochure. *Indicate No. 553 on card.* **A 20-page brochure** on magnetic starters. *Indicate No. 554 on card.* **Controls** for meeting OSHA requirements are covered in this 8-page brochure. *Indicate No. 555 on card.* **Heavy-duty oiltight pushbuttons** are covered in this 10-page brochure. *Indicate No. 556 on card.* **A 20-page brochure** on programmable controllers. *Indicate No. 557 on card*

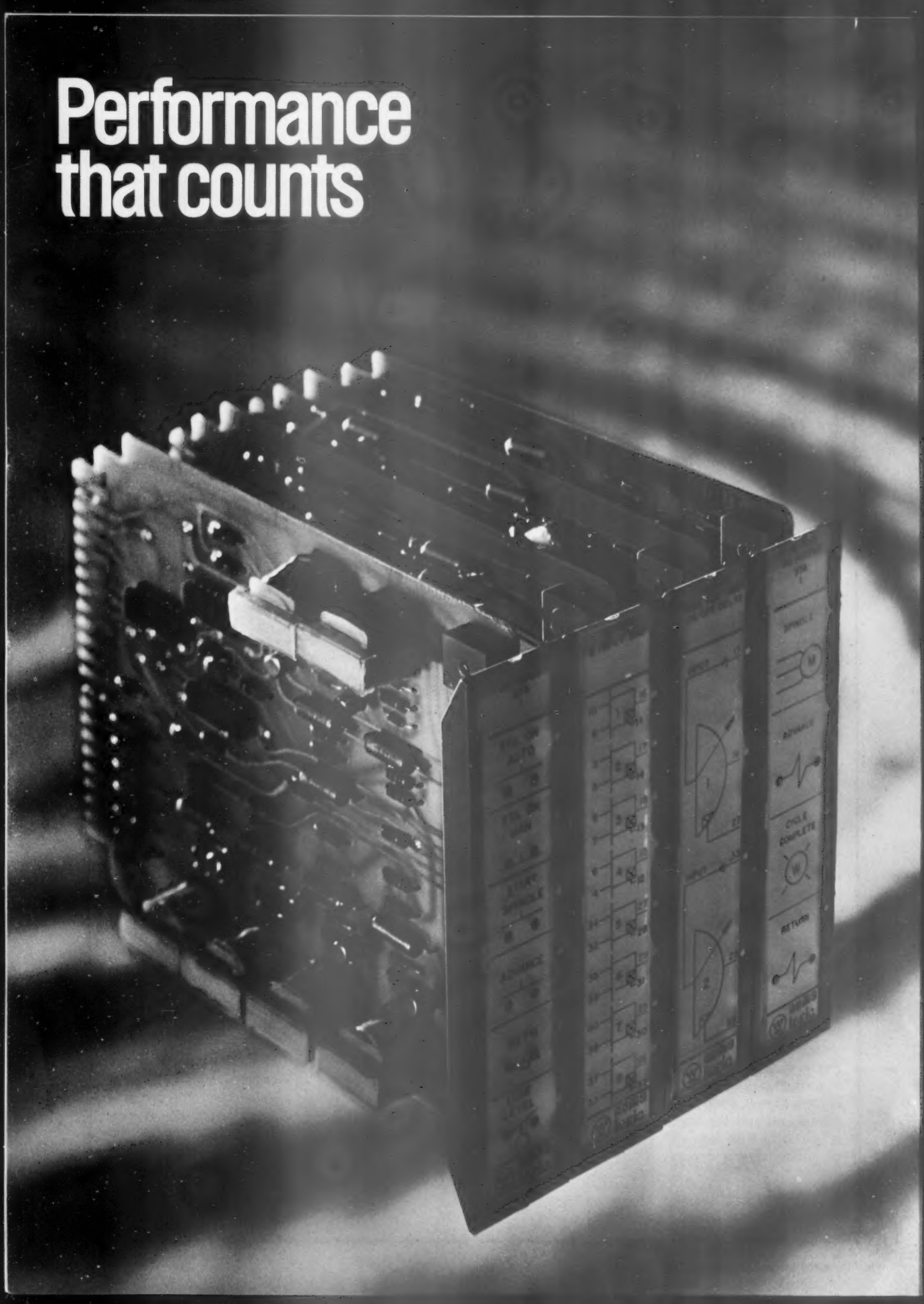
Various brochures on numerical control are offered



in a folder package. (Bendix Industrial Controls Division)
Indicate No. 558 on card

"A confidential competitive comparison" of the Auto-Mate 32 and other programmable controllers is provided in Reliance Electric Co.'s brochure discussing the nine buying considerations in this kind of equipment control.
Indicate No. 559 on card

Performance that counts



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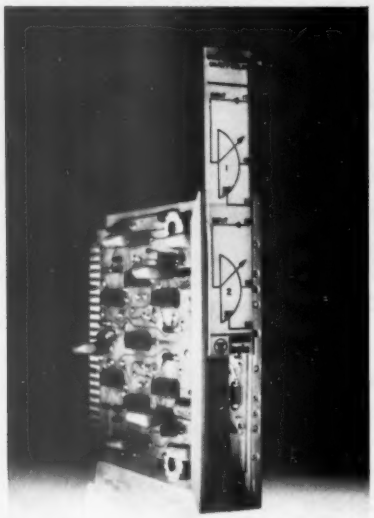

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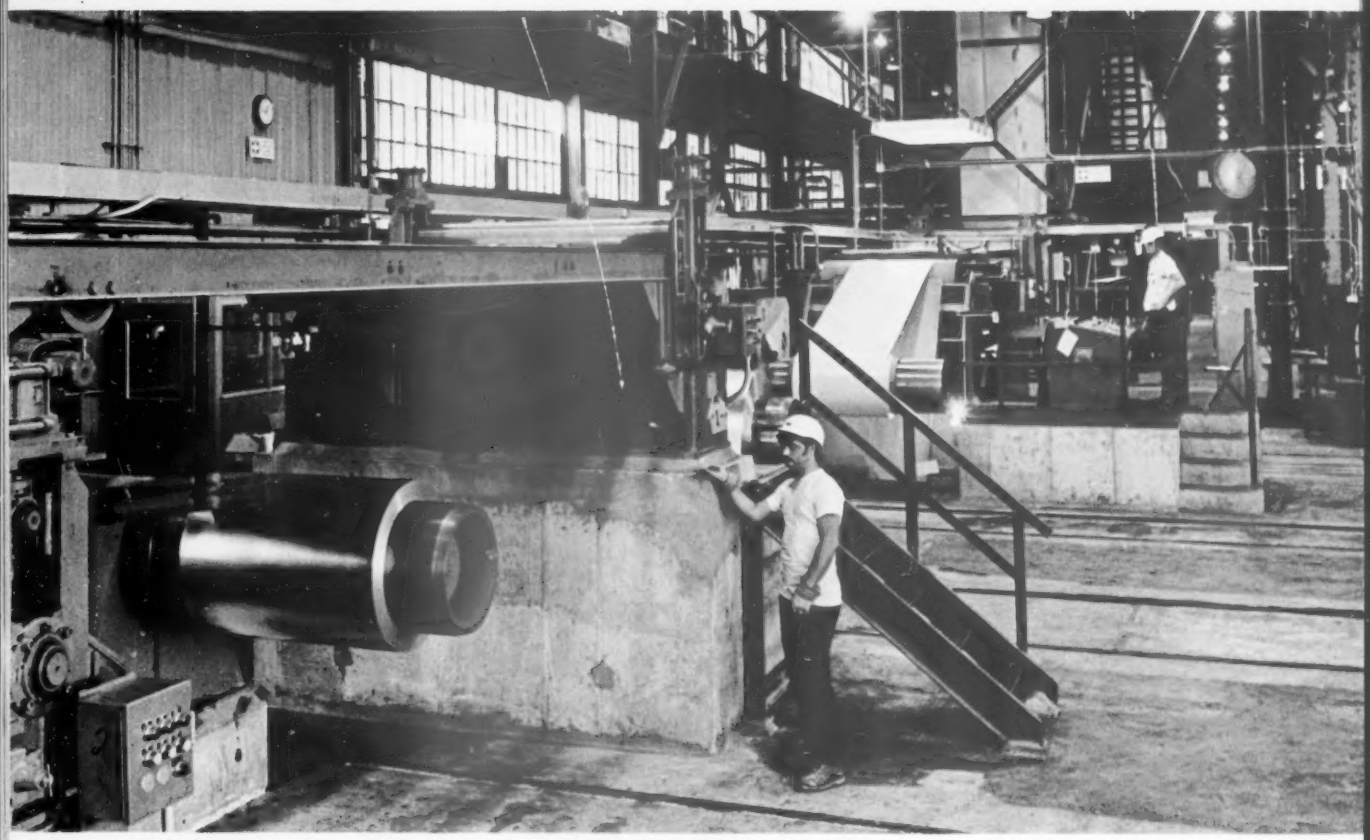

...and St. Louis clean air

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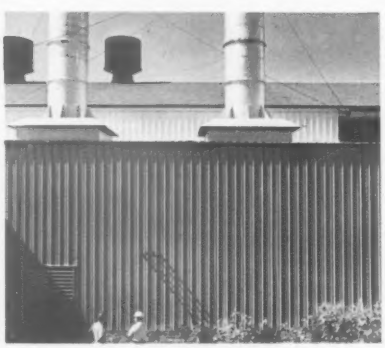

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